OPS/HCP/HCV/INPPAZ/FOS/3.00

Foodborne Diseases (FBD)
Bibliography

Veterinary Public Health Program (HCV)

Integrated Management of Childhood Illness (IMCI)

Pan American Institute for Food Protection and Zoonoses (INPPAZ)

Program on Communicable Diseases (HCT)

Division of Disease Prevention and Control (HCP)

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1. INTRODUCTION

News on populations affected by foodborne disease outbreaks caused by microbiological agents continues to reach the INPPAZ almost daily. The increase in food trade both within the countries and at the international level has contributed to this situation. In most countries in the American Region outbreaks originate in Salmonella spp and Staphylococcus spp; in others, Escherichia coli 0157:H7, Listeria monocytogenes, Campylobacter jejuni, Cyclospora cayetanensis, Clostridium botulinum, Clostridium perfringes and hepatitis A virus also played a significant role.

Fortunately, the countries in Latin American and the Caribbean have taken into account the orientations set forth by the Pan American Health Organization (PAHO) through its Pan American Institute for Food Protection and Zoonoses INPPAZ). Since 1995 they have given a new direction to their foodborne disease surveillance systems and are successfully compiling information on FBD outbreaks with specifications on number of cases, etiological agents, food involved, and place of occurrence. Once the collected information has been analyzed and used as a basis to orient their prevention and control programs, the countries send it to the regional information and surveillance system, coordinated by the INPPAZ. The Institute, in turn, distributes this information to all the countries and international agencies involved.

We are aware that the percentage of underreporting is still significant and that the quality of information needs to be improved. Notwithstanding this, the Region's current surveillance infrastructure will no doubt prove to be very useful for obtaining the information needed to orient decision-making both in the countries and the region on measures aimed at the prevention and control of foodborne diseases.

On the other hand, information on the incidence of FBD will make it possible for the countries to conduct the risk analysis studies that are the scientific basis for international trade and, consequently, to comply with the quality assurances required.

The availability of information is also the basis for the implementation of the hazard analysis and critical control point system because awareness on the microbiological dangers involved facilitates the identification of critical control points and the adoption of the pertinent corrective measures and controls.

With the help of their FBD surveillance systems, the countries will be able to identify rapidly outbreaks of both emerging and reemerging diseases – of great frequency in some of them - and to establish with certainty whether they exist within their frontiers. To state simply that they do not exist without the support of a surveillance system is unacceptable because no scientific evidence can be provided

The implementation of FBD surveillance systems as a sanitary measure in every country is essential to certify the equivalence of food control and inspection services.
The evaluation of such systems shows that their organization and operation within the framework of national disease surveillance systems are possible. But adequate operation requires full coordination among the different sectors involved, such as the epidemiological surveillance departments, the food analysis units and the medical services responsible for patients'care. In addition, consumers' involvement is essential because it is they who are directly affected by FBD diseases and who, for lack of information, may handle the food incorrectly thereby turning ineffective the preventive measures taken throughout the production chain.

The Region's current surveillance infrastructure will no doubt prove to be very useful for obtaining the information needed to orient decision-making both in the countries and the region on measures aimed at the prevention and control of foodborne diseases.

On the basis of this evaluation it was found necessary to define the need for incorporating into the reports the risk factors that lead to the occurrence of outbreaks, such as storage temperature, duration of the cooking

process, and the water used. With such information it will be possible to identify the main problems that generate outbreaks, while contributing to the improvement of prevention and control measures.

Through the INPPAZ and the consultants in the countries, the PAHO will continue to provide its support to the national services for the further development of FBD surveillance systems. It will likewise continue to coordinate the regional system so that the information is distributed to all the countries and applied by them in their prevention and control programs and for the promotion of food trade within and outside the region. Moreover, the regional system is being interconnected with the systems in other continents so that our region may be fully aware of the potential risks that could affect it.

In most of the developing countries of the American Region, Foodborne Diseases (FBD), diarrheal diseases (DD), and malnutrition are some of the major causes of illness and death.

People in developing countries are exposed to a combination of illness and death risk factors that result in deaths.

The advances made in the prevention and control of these health related problems and the way in which disease develops differs in each country. These differences are attributed to a variety of factors that directly and indirectly affect the progress of implementing prevention and control strategies, including problems associated with the organization of the health sector and the overall transitional process that developing countries are experiencing in the educational, social, political, and economic planning sectors.

Efforts to identify common ground interventions to reduce FBD morbidity and mortality are reflected in the goals outlined in the programatic and strategic orientations of the Pan American Health Organization. This interest is also reflected in other recent governmental discussions, including the RIMSA XI 1999 in Washington , DC which recommended an integrated approach for strengthening health actions.

In recent years, FBD have become a high priority for developing countries as well as for international organizations. Thus, the design and implementation of strategies aimed to decrease the morbidity and mortality of prevalent FBD should be a primary component within the primary health care framework.

The Veterinary Public Health Program, through the Pan American Institute for Food Protection and Zoonoses has been designed as a care strategy to be utilized in basic health services. The focus of this strategy is on the major causes of illness and death in people in developing countries.

FBD are diseases of global importance that has concerned toxicologists, infectious diseases specialists, cholera historians and public health specialists for almost the last 10 years.

The current global situation of FBD, with endemic areas scattered throughout the Americas, Africa, and Asia, serves as a stark reminder of the deficiencies in water quality, food sanitation, and hygiene that will continue to challenge governments and health agencies into the next millennium.

The detection of *Vibrio cholerae O1* in patients from a Peruvian coastal village in January 1991 signaled the arrival of the seventh pandemic of cholera to Latin America. Cholera now has extended throughout Latin and Central America and continues to spread. Although it has not sustained its epidemic levels of 1991, it still serves as a reminder in 1998 of inherent public health deficiencies in the region. Due to under-reporting and inefficient surveillance systems, the more than 1.3 million cases and 12,00 deaths notified in Latin America by the end of 1997 represent only a small fraction of the real number of infections.

At the beginning of the latest epidemic, the Pan American Health Organization (PAHO) intensified prevention and control efforts. Project support for the essential aspects of epidemiological surveillance, laboratory

diagnosis, proper case management, desinfection of water and food, and social communication and education were implemented in coordination with Ministers of Health and the international community.

However, efforts to decrease mortality represent one of the true success stories of the current program. This success may be due to early efforts to strengthen training in proper case management of national FBD and diarrheal disease control programs, to mobilize international and bi-lateral funds in support of country intervention and prevention projects, and to establish interagency collaborative support with countries.

Presently, in the Region of the Americas training in the prevention and proper case management of FBD, including cholera, diarrhea and monitoring and surveillance activities are integral components of the WHO/PAHO/HCP/HCV/INPPAZ strategy. The Organization is one of the leading partners in the hemisphere coordinating activities with Member Countries.

For years efforts have been made to control these FBD infections in Latin America. They have produced fleeting benefits. The Pan American Health Organization, and others, state that well supported and managed FBD control programs have the potential to contribute to the health and intellectual development of very large numbers of people. Thus, the scale of the problem and the size of the potential benefits could warrant a global effort.

The Program on Veterinary Public Health (HCV) from the Division of Disease Prevention and Control (HCP), has promoted the implementation of the Standardized Protocol for the Control of FBD in the Region of the Americas since 1991. This approach is aimed at reducing morbidity from FBD pathogens, through a package of interventions that include targeted and improved health education and social communication practices, and the promotion of environmental sanitation.

Most programs in the past had common failures: insufficient data collection, inadequate follow up, and the inability at the end of the program to measure the impact of the intervention and its successes, and therefore ultimately, the inability to justify its continuation and additional investments. Causes for these failures included the lack of monitoring and evaluation tools to gather, analyze data, and document the experience, as well as to base further research, and the lack of access to scientific publications and instructional manuals.

The current tools for the control of FBD infections and can achieve a substantial impact on health both through specific control programs and through integration with existing health programs including environmental sanitation and improvement, prevention and control of diarrheal diseases (CDD), maternal and child health, nutrition, and, of course, health education and mass communication.

WHO/PAHO/INPPAZ` s success will be determined by the availability of treatment and the continued integration of efforts through existing health programs.

2. PROJECT OBJECTIVE

The purpose of this bibliography is to disseminate the latest scientific information available in support of the implementation of the WHO/PAHO/HCP/HCV/INPPAZ program. It is offered to health personnel as a reference source for the development of studies and operational research and to the teachers of pediatrics as a support document.

This bibliography is being made available to health personnel as a reference source for documentation purposes and the development of operational research. It is also offered as guidelines to general practitioners who daily deal with these prevalent diseases. It intends to be selective of the most relevant and recent materials related to

the WHO/PAHO/INPPAZ components. We hope it will be useful in addressing the needs for knowledge on the FBD in people of the Americas.

This comprehensive bibliography deals with all aspects of FBD prevention, epidemiology of FBD infection, and other scientific background. Knowledge gained by research on FBD has been fundamental, not only to understanding FBD in general, but also to gaining knowledge and experience to permit a more rational and effective handling of FBD. We hope that this bibliography will have longlasting value for students, health workers, and other individuals interested in FBD, cholera and diarrheal diseases.

This Bibliography is going to be distributed massively, and it is hoped that recipients find it a useful source of information.

3. PROJECT DEVELOPMENT

Rapid dissemination of new research findings of relevance for the WHO/PAHO/INPPAZ Strategy is recognized as being of vital importance. To help provide this information, the *FBD Bibliography* is being created by searching online the National Library of Medicine's (NLM) MEDLINE database (1990-1999) and creating a first set of data using the medical subject headings (MeSH) **FOOD** (pre-explored). This set was then combined with each of the MeSH headings selected for this bibliography. The following MeSH subheadings are going to be applied to the search:

Complications	Epidemiology	Microbiology	Parasitology
Diagnosis	Etiology	Mortality	Pesticides
Drug Therapy	Immunology	Therapy	Chemicals
Economics	Prevention & Control	Virology	Bacteriology
Transmission	Food Safety	Education	HACCP System
Diseases	Morbility	Surveillance	Community Health
Social Communication			

4 THE PAN AMERICAN INSTITUTE FOR FOOD PROTECTION AND ZOONOSES

The Pan American Institute for Food Protection and Zoonoses (INPPAZ) was created on 15 November 1991 through an agreement with the Government of Argentina, in response to a request made by the Director of the Pan American Health Organization, Regional Office of the World Health Organization (PAHO/WHO) and the ministers of health and agriculture of the Member Governments in April of the same year, to the effect that it continue to provide technical cooperation on a comprehensive and permanent basis in the field of food protection and zoonosis control. The INPPAZ has its headquarters in Martínez, Province of Buenos Aires, and is part of the network of PAHO specialized centers; technically, it is attached to the Division of Disease Prevention and Control (HCP), and carries out its activities in coordination with the Program on Veterinary Public Health and the PAHO/WHO Representative Offices in the countries.

Mission

"To provide the Member Governments of the Organization, as well as their initiatives for integration, with international references services, technical cooperation, and research for the solution of problems related to food protection, zoonosis control and the strengthening of health and agriculture laboratories."

4.1 STRUCTURE

The organizational chart of the Institute comprises the Office of the Director and three Groups: a) Program development, b) Standardization, regulations and reference, and c) Training and information, and three supporting units: Administration, Systems, and Engineering and Maintenance. In addition, the INPPAZ PAHO/WHO has three advisory bodies:

- The International Coordination Council (ICC): composed of the Ministers of Health and of Agriculture of the countries in the Region, whose function is to advise the Director of the Organization on the orientation of the Institute's priorities and strategies, the evaluation of its activities and the fulfillment of the agreement between the Government of Argentina and the Organization. The Council held meetings in 1993, 1994, and 1997, respectively.

- The Scientific and Technical Committee (STC): composed of experts convened by the Director of the Organization for the development and scientific and technical analysis and evaluation of the INPPAZ program of work. It held two meetings, the first in 1994 and the second in February 1999.

- The Program Committee for Argentina (PCA): composed of representatives of the Ministry of Health and the Secretariat of Agriculture, Livestock, Fishing and Nutrition of Argentina, and of PAHO. It provides support to the programming, execution and evaluation of the technical cooperation activities that the INPPAZ carries out in Argentina. This Committee holds annual meetings.

4.2 PROGRAM

The technical cooperation that the INPPAZ provides to the countries in compliance with the mandates and recommendations of the Governing Bodies of PAHO and the Institute's advisory bodies, consists in its technical and operational support for the development of two projects: the Regional Program for Technical Cooperation in Food Protection, and the Program for the Prevention, Control and Elimination of the Zoonoses: rabies, tuberculosis, brucellosis, and other.

The fundamental purpose of the Institute's Program for Technical Cooperation is to reduce the risks for human populations resulting from food-borne diseases and from communicable diseases from animals to man.

The project on food protection is a part of the PAHO Regional Program for Technical Cooperation and its structure includes the following five components:

· Organization of national integrated food protection programs

· Strengthening of the analytical capacity

· Strengthening of the inspection services

· Epidemiological surveillance of food-borne diseases

· Food protection promotion through community involvement.

In the project related to the zoonoses, priority was given to rabies and tuberculosis. As regards other zoonoses, the Institute responded to special requests for cooperation from the countries.

In programming the activities for the period, special account was taken of the recommendations of the External Working Group convened in 1996 to advise the Director of PAHO on the Program on Veterinary Public Health. Those recommendations, which had been approved by the Governing Bodies, stated that when programming its activities, the Institute should give priority to providing the countries with technical cooperation in food protection.

In carrying out the programs with the countries, the Organization's points of view on technical cooperation are followed, including those on the development of policies, plans and regulations, training, dissemination of information, research, direct technical cooperation, and mobilization of resources. Use is made of PAHO's infrastructure in the countries , as well as of the INPPAZ consultants and those of the Program on Veterinary Public Health in the central office and in the countries.

5. FOOD PROTECTION

Foodborne diseases (FBDs) constitute a public health problem and lead to decreased economic productivity as a result of diarrhea in children and adults, cholera, salmonellosis, listeriosis, infections from enterohemorrhagic *Escherichia coli*, and chronic poisoning caused by chemical contaminants. In addition to the suffering they cause, FBDs impose a substantial economic toll on those affected and their families, as well as on industry and health care systems.

Outbreaks of foodborne disease affect tourism and trade. In 1991, the cholera epidemic in Peru led to a loss of US$ 600 million due to the temporary halt in fish and shellfish exports. A further US$ 70 million was lost in the first three months of the epidemic from the shutdown of food production facilities and the decrease in tourism. The World Health Organization estimates that, in 1993, FBDs produced world-wide losses of approximately US$ 380 million in the international food trade. This serious impact, however, is not reflected in the limited funds allocated to programs specifically aimed at controlling food safety and quality.

6 FOODBORNE DISEASES

During 1995 and 1996, 1,669 outbreaks of FBDs were reported in the Region, causing 57,455 people to become ill. Since the number of reported outbreaks and of cases is a function of the quality and sensitivity of the countries' systems for monitoring FBDs, the information presented here represents a small proportion of the actual total. Furthermore, it is believed that countries reporting a large number of cases have highly sensitive systems, but because of the lack of specificity in the reports, there is no detailed information as to etiology and other factors related to the diseases.

During 1995 and 1996, there were 144 deaths. Of that number, 102, or 70.8%, resulted from chemical substances caused 73 of those 102 deaths from poisoning, and that methanol was the most important etiological agent (62 cases). Information on the type of illness in the outbreaks of FBDs points up the large proportion of cases where the etiological agent was unspecified. In outbreaks where the cause is known, infections are most frequent, but the highest mortality comes from poisonings. Further, it can be seen that *Salmonella* is responsible for the greatest number of cases, 9,730 during 1995 and 1996.

7 STRATEGIC PLAN OF ACTION

7.1 REVISED MISSION

"To provide the Member Governments of the Pan American Health Organization and their integration initiatives with technical cooperation for the solution of problems related to food safety and to the prevention and control of food-borne diseases in the population. "

7.2 FUNCTIONS

1. To promote the updating and adoption of legislation and regulations on food safety.

2. To train officials from the countries in the Region.

3. To provide international reference services for the detection of microbiological, chemical and natural contaminants.

4. To collect and disseminate epidemiological and technical information on food safety..

5. To coordinate applied research regarding food safety.

6. To provide direct technical advisory services for the organization of integrated food protection programs.

7. To promote technical cooperation among the countries.

7.3 STRATEGIC ASSUMPTIONS

1. Food safety is a central issue of crucial importance at the national, regional, and world levels because of its consequences for public health and international trade.

2. Problems in food safety have led to important advances in food inspection and control methods through the introduction of preventive measures that cover the food production chain and are based on the principle of hazard analysis.

3. The countries should update their food production programs in order to reduce the risks for the population and, in the case of those with food surpluses, to comply with the requirements of international trade.

4. From the standpoint of public health, greater attention will have to be given the small and medium-sized food industry, which normally produce a significant volume of food for domestic consumption.

5. Special private technical assistance mechanisms have been developed in response to the needs of the exporting and advanced industrial sectors, and several international technical cooperation agencies are collaborating in updating food inspection and control systems (World Trade Organization (WTO), FAO, PAHO, WHO, and IEO).

6. The significant advances in the communication technology currently available contribute to facilitating the implementation of training and social communication programs.

7. All the countries in the Region are at the stage of undertaking state reforms and reducing the services provided by the state, with a trend toward their privatization.

8. As a result of the technical cooperation provided by PAHO and other international organizations, the countries already have the basic infrastructure required for food production programs that can be used to improve food safety and strengthen technical cooperation among the countries.

9. Through the INPPAZ and the Program on Veterinary Public Health, PAHO has played a very important role in providing technical cooperation to the countries. However, its efforts have not yet achieved the scope

required to satisfy the current and future technical cooperation needs of the countries as established in the above assumptions because of the uncertainty regarding the availability of resources.

10. The existing WHO Collaborating Centers and the national and international activities in food protection could be used to strengthen the technical cooperation provided to the countries through coordinated activities and alliances.

11. PAHO has a remarkable infrastructure in the region consisting of its PWRs, the Technical Programs, and the epidemiologists and consultants in the countries with which, and through adequate programming coordination, technical cooperation to the countries could be significantly increased.

12. The available information on food-borne disease cases shows that they occur most frequently in the homes; this calls for an extensive social communication and health education campaign.

FOODBORNE DISEASES (FBD)

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AUTHOR SECTION
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Abbassy M.M. et al. *New artificial feeding technique for experimental infection of Argas ticks (Acari: Argasidae).* J Med Entomol. 1994; 31(2) : 202-5.p Abstract: An artificial feeding technique using fetal bovine serum as a food source was established for the demonstration of West Nile virus transmission by Argas ticks in susceptibility studies. Fetal bovine serum does not coagulate and is free from contaminating microorganisms, antibodies, and anticoagulants, which are all known to reduce virus titers. This technique also compensates for the lack of suitable laboratory hosts as well as problems associated with disease agents, such as viruses that may not produce illness or antibodies after virus exposures.

Abdussalam M. et al. *Food safety in primary health care.* World Health Forum. 1994; 15(4) : 393-9.p Abstract: Efforts to ensure food safety through legislation have been only partially successful, and the prevalence of foodborne disease is increasing in most countries. Health education on a large scale is needed to raise the level of public awareness of the factors leading to the spread of these diseases. The best way to do this is through the primary health care system, basing activities on both scientific knowledge and local food-related customs and behaviour.

Abeyta C. Jr et al. *Iron milk medium method for recovering Clostridium perfringens from shellfish: collaborative study.* J AOAC Int. 1994; 77(2) : 351-6.p Abstract: Eleven laboratories participated in a collaborative study analyzing shellfish (oysters, Crassostrea gigas) for the detection and enumeration of Clostridium perfringens by the iron milk medium (IMM) method. The IMM method was compared to AOAC Official Method 976.30. Shellfish were artificially inoculated with C. perfringens cells (vegetative and spores) at low (1 x 10(3) colony forming units [cfu]/g), medium (1 x 10(4) cfu/g), and high (1 x 10(6) cfu/g) levels. Negative controls (zero level) were analyzed by each laboratory. C. perfringens FD-1, the strain involved in a foodborne illness, was used. Blind duplicates of each inoculum level were analyzed, giving a total of 16 samples per laboratory. The selectivity of IMM relies solely on the rapid growth of C. perfringens at 45 degrees C indicated by stormy fermentation reaction within 18 h. C. perfringens is detected and enumerated using the most probable number technique. A statistical evaluation of the data found no significant differences between the estimates from the 2 methods. The IMM method for detection of C. perfringens from shellfish has been adopted first action by AOAC INTERNATIONAL.

Ackers M.L. et al. *An outbreak of Escherichia coli O157:H7 infections associated with leaf lettuce consumption.* J Infect Dis. 1998; 177(6) : 1588-93.p Abstract: In July 1995, 40 Montana residents were identified with laboratory-confirmed Escherichia coli 0157:H7 infection; 52 residents had bloody diarrhea without laboratory confirmation. The median age of those with laboratory-confirmed cases was 42 years (range, 4- 86); 58% were female. Thirteen patients were hospitalized, and 1 developed hemolytic-uremic syndrome. A case-control study showed that 19 (70%) of 27 patients but only 8 (17%) of 46 controls reported eating purchased (not home-grown) leaf lettuce before illness (matched odds ratio, 25.3; 95% confidence interval, 3.9-1065.6). Pulsed-field gel electrophoresis identified a common strain among 22 of 23 isolates tested. Implicated lettuce was traced to two sources: a local Montana farm and six farms in Washington State that shipped under the same label. This outbreak highlights the increasing importance of fresh produce as a vehicle in foodborne illness. Sanitary growing and handling procedures are necessary to prevent these infections.

Ackers M.L. et al. *An outbreak of Yersinia enterocolitica O:8 infections associated with pasteurized milk.* J Infect Dis. 2000; 181(5) : 1834-7.p Abstract: In October 1995, an outbreak of Yersinia enterocolitica O:8 infections occurred in the Upper Valley of Vermont and New Hampshire. Ten patients were identified, median age 9 years (range, 6 months-44 years). Three patients were hospitalized; 1 underwent an appendectomy. Consumption of bottled pasteurized milk from a local dairy was associated with illness (matched odds ratio undefined; lower 95% confidence interval, 1.9). No deficiencies in pasteurization procedures or equipment were detected. Y. enterocolitica O:8 was isolated from 1 raw-milk sample and from a fecal sample from 1 dairy pig. The route of contamination was not determined; this outbreak likely resulted from postpasteurization contamination of milk. Dairy pigs were the most likely source of contamination. Milk bottles were likely contaminated by rinsing with untreated well water prior to filling or by other environmental routes. Educating dairy owners about Y. enterocolitica and postpasteurization contamination is necessary to prevent further outbreaks.

Adak G.K. et al. *PHLS begins a national case control study of Escherichia coli O157 infection in England.* Commun Dis Rep CDR Rev. 1996; 6(10) : R144-6.p Abstract: Infection with Vero cytotoxin producing Escherichia coli O157 (VTEC O157) is a growing public health problem and the commonest cause of acute renal failure in children in the United Kingdom. Foodborne outbreaks of VTEC O157 infection have been reported in the United Kingdom, other European countries, and North America. Most cases of infection are sporadic, however, and the contribution of food vehicles, animal contact, and person to person spread in the acquisition of infection needs to be clarified. The PHLS is starting a case control study in England to identify and estimate the relative importance of risk factors for the acquisition of VTEC O157 infection. The study will run for 12 months. This article describes its objectives and asks microbiologists, public health physicians, clinicians, and others who may be asked for details about cases or to find

suitable controls for their help in achieving a successful outcome.

Adorjan T. et al. *[Botulism. Summary based on six cases (see comments)].* Orv Hetil. 1998; 139(42) : 2495-500.p Abstract: Botulism is a rare neuroparalytic disease caused by neurotoxins of Clostridium species. In Hungary it most commonly occurs as a foodborne illness with ocular and bulbar paralysis, muscle weakness and gastrointestinal symptoms. Six cases of botulism were observed by the authors, first in 1993 five members of a family, then in 1997 a patient with sporadic illness. The diagnosis was confirmed by toxin tests in addition to the symptoms and food history. Recognition of the epidemiologic associations proved very useful in the confirmation of outbreak-related cases. The illness was moderately serious at three patients and mild at two patients. One of the patients had a cirrhosis of the liver, and her status became critical because of the repeated bleeding from oesophagus varicose vein. The patient with sporadic illness had a serious gastric dilatation and palsy of bowels causing paralytic ileus at the start of the illness. The symptoms regressed slowly, roughly in three weeks, at all patients. Death did not happened. After the case reports the authors review the disease-microorganism, toxin, clinical entities, incidence, symptoms, diagnosis, differential-diagnosis, and finally the treatment.

Ahl A.S. et al. *Risk and the food safety chain: animal health, public health and the environment.* Rev Sci Tech. 1997; 16(2) : 322-30.p Abstract: Food safety related to the consumption of animal-derived protein encompasses a wide variety of production and processing procedures which begins with the farm and inputs to the animals on the farm (e.g. feed and water) and includes the environment in which animals are reared. Hazards may be physical, artificial or naturally-occurring chemicals, organisms which cannot reproduce outside a specified life-cycle (e.g., parasites such as tapeworm in pigs) or viruses. Other microbes reproduce in the gastrointestinal tract of food animals as well as on the surface of food and in the environment. Methods of risk assessment for physical and chemical hazards have been used for many years. However, with microbial pathogens which can survive and grow on meat, in soil, water or other media, risk assessment methods are at the early stages of development. Due to the broad habitat range, the role of microbial pathogens in the food safety of meat, poultry, fruit and vegetables is important. The use of antibiotics in livestock species may accelerate the development of antibiotic-resistant strains of microbial pathogens, potentially complicating treatment for both animals and humans. The authors discuss the food chain, risk analysis and hazard analysis and critical control points in relation to foodborne pathogens, and introduce general strategies for improving pathogen control on the farm.

al-Sheddy I.A. et al. *Microbiology of fresh and restructured lamb meat: a review.* Crit Rev Microbiol. 1995; 21(1) : 31-52.p Abstract: Microbiology of meats has been a subject of great concern in food science and public health in recent years. Although many articles have been devoted to the microbiology of beef, pork, and poultry meats, much less has been written about microbiology of lamb meat and even less on restructured lamb meat. This article presents data on microbiology and shelf-life of fresh lamb meat; restructured meat products, restructured lamb meat products, bacteriology of restructured meat products, and important foodborne pathogens such as Salmonella, Escherichia coli 0157:H7, and Listeria monocytogenes in meats and lamb meats. Also, the potential use of sodium and potassium lactates to control foodborne pathogens in meats and restructured lamb meat is reviewed This article should be of interest to all meat scientists, food scientists, and public health microbiologists who are concerned with the safety of meats in general and lamb meat in particular.

al-Zubaidy A.A. et al. *An outbreak of typhoid fever among children who attended a potluck dinner at Al-Mudhnab, Saudi Arabia.* East Afr Med J. 1995; 72(6) : 373-5.p Abstract: In June 1992, 19 cases of typhoid fever were reported from the town of Al-Mudhnab town (population 10,000) in the Qassim region of central Saudi Arabia. Ten of the cases were females (53%), and these were clustered by onset in a 15-day period. Cases in boys followed the girls and were more dispersed over time. Cases included 14 school-age children, four pre-school children, and the wife of a girls' school bus driver. The attack rates (AR) did not differ between boys' and girls' schools and ranged from 5.5 to 15.87 per 1,000 in six different schools. All patients except one lived within two blocks in one quarter of the town. Typhoid fever was associated with attending a school potluck dinner (OR = 5.31; 95% CI 1.02, 28.85) or eating food prepared for that dinner (OR = 6.95; 95%; CI 1.40, 36.61). Cake with cream topping from the dinner was kept overnight at room temperature and served to girls on the bus the next day. The OR of eating leftover cake on the school bus and becoming ill was 11.04 (95%; CI 1.59, 95.27). The localization of this outbreak by time and place and by the age groups affected, supports the conclusion that the outbreak was foodborne. The most likely food was cream topping on the cake. Lessons on proper food handling and storage should be included in home economics classes.

Alak J.I. et al. *Supplementation with Lactobacillus reuteri or L. acidophilus reduced intestinal shedding of cryptosporidium parvum oocysts in immunodeficient C57BL/6 mice.* Cell Mol Biol (Noisy-le-grand). 1999; 45(6) : 855-63.p Abstract: The effect of L. acidophilus supplementation to reduce fecal shedding of Cryptosporidium parvum oocysts was compared to L. reuteri using C57BL/6 female mice immunosuppressed by murine leukemia virus (strain LP-BM5) inoculation. After 12 weeks post LP-BM5 inoculation, 15 immunosuppressed mice each were randomly assinged to one of the following treatment groups: historical control (group A), LP-BM5 control (group B), C. parvum (group C), L. reuteri plus C. parvum (group D) or L. acidophilus plus C. parvum (group E).

Mice were pre-fed the L. reuteri or L. acidophilus bacteria strains daily for 13 days, challenged with C. parvum oocysts and thereafter fed the specified Lactobacillus regimens daily during the experimental period. Animals supplemented with L. reuteri shed fewer ($p<0.05$) oocysts on day-7 post C. parvum challenge compared to controls. Mice supplemented with L. acidophilus also shed fewer ($p<0.05$) oocysts on days 7 and 14 post-challenge compared to controls. Overall, Lactobacillus supplementation reduced C. parvum shedding in the feces but failed to suppress the production of T-helper type 2 cytokines [interleukin-4 (IL-4), IL-8)] which are associated with immunosuppression. Additionally, Lactobacillus supplementation did not restore T-helper type 1 cytokines (interleukin-2 (IL-2) and gamma interferon (IFN-gamma), which are required for recovery from parasitic infections. Altered T-helper types 1 and 2 cytokine production as a consequence of immunodysfunction permitted the development of persistent cryptosporidiosis while mice with intact immune system were refractory to infection with C. parvum. Reduction in shedding of oocysts observed in the Lactobacillus supplemented mice during deminished IL-2 and IFN-gamma production may be mediated by factors released into the intestinal lumen by the Lactobacillus and possibly other host cellular mechanisms. These observations suggest that L. reuteri or L. acidophilus can reduce C. parvum parasite burdens in the intestinal epithelium during cryptosporidiosis and may serve potential benefits as probiotics for host resistance to intestinal parasitic infections. L. acidophilus was more efficacious in reducing fecal shedding than L. reuteri and therefore may also have implication in the therapy of cryptosporidiosis during immunosuppressive states including human AIDS.

Albert M.J. et al. *The role of food in the epidemiology of cholera.* World Health Stat Q. 1997; 50(1-2) : 111-8.p Abstract: Cholera is an acute dehydrating diarrhoeal disease, traditionally caused by vibrio cholerae O1, and also more recently by V. cholerae O139 (Bengal). Traditionally, water was recognized as the primary vehicle for transmission of cholera, but in the past 30 years, outbreaks of cholera associated with eating contaminated food have demonstrated that food also plays an important role, although in many instances water is the source of contamination of foods. Most commonly associated with cholera is seafood, both molluscan shellfish and crustaceans. Seafood may be contaminated in its natural environment or during preparation. Other food items associated with outbreaks are fruit and vegetables, meat, cooked grains, etc. Vegetables are usually contaminated by contact with sewage in soil and fruits when injected with contaminated water to increase weight and turgor. Food items initially free from V. cholerae organism may become contaminated when mixed with water, or other contaminated food, or through handling by infected persons who have not observed proper hygiene. Refrigeration, freezing, alkaline pH, high concentration of carbohydrate, humidity and absence of competing flora enhance the survival of V. cholerae in food. Survival of V. cholerae is shorter in food with acidic pH. Foodborne cholera can be averted by the hygienic preparation of food and its consumption. However, since the vehicles of transmission vary markedly from place to place, being affected by local customs and practices, selected control and preventive measures that are most important locally must be implemented. To this end, application of the Hazard Analysis and Critical Control Point system to food preparation is essential in order to identify the practices which may present a risk. Restrictions on importation of foods which do not present a risk of being contaminated from areas where cholera is endemic is not warranted.

Altekruse S. et al. *Foodborne bacterial infections in individuals with the human immunodeficiency virus.* South Med J. 1994; 87(2) : 169-73.p Abstract: The literature contains reports documenting a foodborne etiology for bacterial infections caused by Salmonella spp, Listeria monocytogenes, Campylobacter jejuni, and Vibrio spp in individuals with the human immunodeficiency virus (HIV). The incidence of these infections and the life-threatening complications that result are elevated in people with HIV infection. We present practical recommendations to prevent foodborne illnesses and the resulting complications, including gastroenteritis, bacteremia, meningitis, and death. We suggest that patients with HIV infection be counseled to avoid foods at high risk for harboring bacterial pathogens and to use careful sanitary practices in food preparation.

Altekruse S.F. et al. *Emerging foodborne diseases.* Emerg Infect Dis. 1997; 3(3) : 285-93.p Abstract: The epidemiology of foodborne diseases is rapidly changing. Recently described pathogens, such as Escherichia coli O157:H7 and the epidemic strain of Salmonella serotype Typhimurium Definitive Type 104 (which is resistant to at least five antimicrobial drugs), have become important public health problems. Well-recognized pathogens, such as Salmonella serotype Enteritidis, have increased in prevalence or become associated with new vehicles. Emergence in foodborne diseases is driven by the same forces as emergence in other infectious diseases: changes in demographic characteristics, human behavior, industry, and technology; the shift toward a global economy; microbial adaptation; and the breakdown in the public health infrastructure. Addressing emerging foodborne diseases will require more sensitive and rapid surveillance, enhanced methods of laboratory identification and subtyping, and effective prevention and control.

Altekruse S.F. et al. *Campylobacter jejuni--an emerging foodborne pathogen.* Emerg Infect Dis. 1999; 5(1) : 28-35.p Abstract: Campylobacter jejuni is the most commonly reported bacterial cause of foodborne infection in the United States. Adding to the human and economic costs are chronic sequelae associated with C. jejuni infection--Guillian-Barre syndrome and reactive arthritis. In addition, an increasing proportion of human infections caused by C. jejuni are resistant to antimicrobial therapy. Mishandling of raw poultry and consumption of

undercooked poultry are the major risk factors for human campylobacteriosis. Efforts to prevent human illness are needed throughout each link in the food chain.

Altekruse S.F. et al. *Consumer knowledge of foodborne microbial hazards and food-handling practices.* J Food Prot. 1996; 59(3) : 287-94.p Abstract: A national telephone survey was conducted of 1,620 randomly selected U.S. residents who spoke English, were at least 18 years old, and resided in households with kitchen facilities. Respondents were interviewed about their recognition of foodborne pathogens, foods at risk for transmitting infection, knowledge of safe food handling, and food-handling practices. One-third of the respondents who prepared meals reported unsafe food hygiene practices: e.g., they did not wash hands or take precautions to prevent cross-contamination from raw meat. Unsafe practices were reported more often by men, adults 18 to 29 years of age, and occasional food preparers than by women, persons 30 years old or older, and frequent food preparers. Respondents who identified a food vehicle for Salmonella spp. were more likely to report washing their hands and cleaning cutting boards after preparing raw meat and poultry. The results raise concerns about consumer food-handling practices. The influence of food safety training, food-handling experience, and age on food-handling practices should be studied further. Awareness of a food vehicle for Salmonella spp., for example, may indicate knowledge of the etiology of foodborne disease that promotes safe food handling. Understanding the factors associated with safe food handling will assist in development of effective safe-food instruction programs.

Altekruse S.F. et al. *The changing epidemiology of foodborne diseases.* Am J Med Sci. 1996; 311(1) : 23-9.p Abstract: The epidemiology of foodborne diseases in the United States have changed in recent decades as new pathogens have emerged, the food supply has changed, and the number of people with heightened susceptibility to foodborne diseases has increased. Emerging pathogens are those that have recently increased or are likely to increase within 2 decades. Emergency is often the consequence of changes in some aspect of the social environment. The global economy, for example, has facilitated the rapid transport of perishable foods, increasing the potential for exposure to foodborne pathogens from other parts of the world. Other factors altering foodborne disease patterns are the types of food that people eat, the sources of those foods, and the possible decline in public awareness of safe food preparation practices. Aging, extension of life expectancy for the chronically ill through medical technology, and the AIDS epidemic have increased the public health impact of foodborne diseases because they increase the proportion of the population susceptible to severe illness after infection with a foodborne pathogen. The evolving epidemiology of foodborne diseases must be monitored and understood to implement appropriate prevention technologies.

Altekruse S.F. et al. *Cheese-associated outbreaks of human illness in the United States, 1973 to 1992: sanitary manufacturing practices protect consumers.* J Food Prot. 1998; 61(10) : 1405-7.p Abstract: To identify contributing factors for cheese-associated outbreaks, we reviewed all cheese-associated outbreaks of human illness reported to the Centers for Disease Control and Prevention (CDC) with onsets during 1973 to 1992. The infrequency of large, cheese-associated outbreaks was notable because such outbreaks had been a frequent public health problem before the mid-20th century. Of 32 reported cheese-associated outbreaks, 11 attributed to manufacturing errors caused most of the illnesses and hospitalizations and all 58 deaths. Important factors in these 11 outbreaks were manufacturing cheese with raw or improperly pasteurized milk and postpasteurization contamination. If current Food and Drug Administration sanitary requirements for cheesemaking had been met, these outbreaks would have been preventable. In two outbreaks of Salmonella infections, fewer than 10 Salmonella per 100 g of cheese were detected. In two outbreaks of Brucella infections, efforts to recover the pathogen from the implicated cheese were unsuccessful, emphasizing the inadequacy of end product testing for assuring consumer safety. Curing cheeses kills most bacteria present in cheeses; however, evidence from sources other than the CDC Foodborne Disease Outbreak Surveillance System suggests that curing alone may not be a sufficient pathogen control step to eliminate Salmonella, Listeria, and E. coli O157:H7 from cheese.

Altekruse S.F. et al. *A multi-state survey of consumer food-handling and food-consumption practices.* Am J Prev Med. 1999; 16(3) : 216-21.p Abstract: INTRODUCTION: In the United States, foodborne infections cause an estimated 6.5-33 million illnesses a year. Also included in the burden of foodborne illnesses are sequelae such as hemolytic uremic syndrome, Guillain-Barre syndrome, and reactive arthritis. Surveillance for risky food-handling and food-consumption practices can be used to identify high-risk populations, develop educational efforts, and evaluate progress toward risk reduction. DESIGN: In 1995 and 1996, Behavioral Risk Factor Surveillance System interviews of 19,356 adults in eight states (1995: Colorado, Florida, Missouri, New York, and Tennessee; 1996: Indiana, New Jersey, and South Dakota) included questions related to food-handling and/or food-consumption practices. Risky food-handling and food-consumption practices were not uncommon. Overall, 19% of respondents did not adequately wash hands or cutting boards after contact with raw meat or chicken. During the previous year, 20% ate pink hamburgers, 50% ate undercooked eggs, 8% ate raw oysters, and 1% drank raw milk. Men were more likely to report risky practices than women. The prevalence of most risky behaviors increased with increasing socioeconomic status. CONCLUSION: Targeted education efforts may reduce the frequency of these behaviors. Periodic surveillance can be used to assess effectiveness. In addition to consumer education, prevention efforts are needed throughout the food chain

including on the farm, in processing, distribution, and at retail.

Andersson A. et al. *What problems does the food industry have with the spore-forming pathogens Bacillus cereus and Clostridium perfringens?* Int J Food Microbiol. 1995; 28(2) : 145-55.p Abstract: Spore-forming bacteria are special problems for the food industry. It is not always possible to apply enough heat during food processing to kill spores, thus we have to take advantage of knowledge of the spore-formers to control them. For the meat industry Clostridium perfringens might become a special problem, although this bacterium mainly causes food poisoning through food served in restaurants, hospitals or homes for elderly people (Cliver, 1987; Reynolds, 1987; Gondrosen et al., 1990). The reason for the food poisoning is always the same: meat-containing dishes stored after cooking with insufficient cooling and reheating (Granum, 1990). Even though it should be relatively easy to control this kind of food poisoning, C. perfringens is still one of the most common sources of foodborne diseases. Proper disinfection is necessary to control this type of food poisoning, as it is now clear that only kitchen strains of C. perfringens are able to produce the large amounts of enterotoxin necessary to cause food poisoning (Granum, 1990; Cornillot et al., 1995). Bacillus cereus is more difficult to control, specifically in the dairy industry, where it is now causing the main problems. Insufficient heating of rice-containing dishes has been known to cause B. cereus food poisoning of the emetic kind for a long time (Kramer and Gilbert, 1989), but will not be dealt with in this paper. There are several reasons for the problems in the dairy industry. First of all it seems to be impossible to completely avoid the presence of B. cereus in all milk samples. Secondly the spores are very hydrophobic (Husmark, 1993), and will attach to the surfaces of the pipelines of the dairy industry, where they might multiply and resporulate. A third problem is that pasteurisation heating is insufficient to kill the spores, while competition from other vegetative bacteria is eliminated. It seems that several B. cereus strains have become psychrotrophic over the years, making possible growth at temperatures as low as 4-6 degrees C (Granum et al., 1993a). None of the methods used to control hygiene in the dairy industry so far are able to control B. cereus. This is a continuously increasing problem for the industry but, with emerging knowledge, we should be able to control it. In this paper we will discuss the problems the food industry is facing with C. perfringens and B. cereus, and how these problems might be solved. We will also give our view on how research might ease these problems in the future.

Angelillo I.F. et al. *Food handlers and foodborne diseases: knowledge, attitudes, and reported behavior in Italy.* J Food Prot. 2000; 63(3) : 381-5.p Abstract: The purpose of this study was to evaluate knowledge, attitudes, and behavior concerning foodborne diseases and food safety issues among food handlers in Italy. Face-to-face interviews were conducted within a random sample using a structured questionnaire. Of the 411 food handlers responding, 48.7% knew the main foodborne pathogens (Salmonella spp., Staphylococcus aureus, Vibrio cholerae or other Vibrio spp., Clostridium botulinum, hepatitis A virus), and this knowledge was significantly greater among those with a higher education level, in practice from a longer period of time, and who had attended education courses ($P < 0.05$). A vast majority (90.4%) correctly indicated those foods classified as common vehicles for foodborne diseases, and only 7.1% of food handlers were able to name five different food vehicles, each of which transmit one of the five pathogens. The proportion of those who were able to specify a food vehicle that transmitted hepatitis A virus was significantly higher for those with a higher educational level and with a longer food-handling activity. A positive attitude toward foodborne diseases control and preventive measures was reported by the great majority of food handlers, and it was more likely achieved by those who had attended education courses. This attitude was not supported by some of the self-reported safe practices observed for hygienic principles, because only 20.8% used gloves when touching unwrapped raw food, and predictors of their use were educational level and attending education courses. Results strongly emphasize the need for educational programs for improving knowledge and control foodborne diseases.

Angulo F.J. et al. *A large outbreak of botulism: the hazardous baked potato.* J Infect Dis. 1998; 178(1) : 172-7.p Abstract: In April 1994, the largest outbreak of botulism in the United States since 1978 occurred in El Paso, Texas. Thirty persons were affected; 4 required mechanical ventilation. All ate food from a Greek restaurant. The attack rate among persons who ate a potato-based dip was 86% (19/22) compared with 6% (11/176) among persons who did not eat the dip (relative risk [RR] = 13.8; 95% confidence interval [CI], 7.6-25.1). The attack rate among persons who ate an eggplant-based dip was 67% (6/9) compared with 13% (241189) among persons who did not (RR = 5.2; 95% CI, 2.9-9.5). Botulism toxin type A was detected from patients and in both dips. Toxin formation resulted from holding aluminum foil-wrapped baked potatoes at room temperature, apparently for several days, before they were used in the dips. Consumers should be informed of the potential hazards caused by holding foil-wrapped potatoes at ambient temperatures after cooking.

Angulo F.J. et al. *Origins and consequences of antimicrobial-resistant nontyphoidal Salmonella: implications for the use of fluoroquinolones in food animals.* Microb Drug Resist. 2000; 6(1) : 77-83.p Abstract: Human Salmonella infections are common; most infections are self-limiting, however severe disease may occur. Antimicrobial agents, while not essential for the treatment of Salmonella gastroenteritis, are essential for the treatment of thousands of patients each year with invasive infections. Fluoroquinolones and third-generation cephalosporins are the drugs-of-choice for invasive Salmonella infections in humans; alternative antimicrobial choices are limited by increasing antimicrobial resistance, limited efficacy, and less desirable pharmacodynamic properties. Antimicrobial-resistant Salmonella results from the use of antimicrobial

agents in food animals, and these antimicrobial resistant Salmonella are subsequently transmitted to humans, usually through the food supply. The antimicrobial resistance patterns of isolates collected from persons with Salmonella infections show more resistance to antimicrobial agents used in agriculture than to antimicrobial agents used for the treatment of Salmonella infections in humans. Because of the adverse health consequences in humans and animals associated with the increasing prevalence of antimicrobial-resistant Salmonella, there is an urgent need to emphasize non-antimicrobial infection control strategies, such as improved sanitation and hygiene, to develop guidelines for the prudent usage of antimicrobial agents, and establishment of adequate public health safeguards to minimize the development and dissemination of antimicrobial resistance and dissemination of Salmonella resistant to these agents.

Angulo F.J. et al. *Bacterial enteric infections in persons infected with human immunodeficiency virus.* Clin Infect Dis. 1995; 21 Suppl 1 : S84-93.p Abstract: We review the epidemiology and prevention of and future research priorities for bacterial enteric infections in persons infected with the human immunodeficiency virus (HIV). HIV-infected persons are more frequently infected with Salmonella, Campylobacter, Listeria, and (possibly) Shigella species than are individuals not infected with HIV. In addition, Salmonella and (possibly) Campylobacter infections are more likely to be severe, recurrent, or persistent and associated with extraintestinal disease when they occur in HIV-infected persons. Infections caused by Shigella and Vibrio species can also result in more serious disease in HIV-infected persons than in those not infected with HIV. Risk of these infections can be reduced with proper precautions, particularly those pertaining to food hygiene, animal contact, and travel. Individuals infected with HIV should be informed of their increased risk of acquiring these diseases and should be counseled on the recommended precautions.

Angulo F.J. et al. *Determining the burden of human illness from food borne diseases. CDC's emerging infectious disease program Food Borne Diseases Active Surveillance Network (FoodNet).* Vet Clin North Am Food Anim Pract. 1998; 14(1) : 165-72.p Abstract: Food borne diseases cause a significant burden of illness in the United States. The Food Borne Diseases Active Surveillance Network (FoodNet), established in 1995, continues to monitor the burden and causes of food borne diseases and provide much of the data to address this public health problem.

Anon. *Aldicarb as a cause of food poisoning--Louisiana, 1998.* MMWR Morb Mortal Wkly Rep. 1999; 48(13) : 269-71.p Abstract: Cholinesterase-inhibiting pesticides (i.e., organic phosphates and carbamates), widely used in agriculture, can cause illness if they contaminate food or drinking water. Aldicarb, a regulated carbamate pesticide, is highly toxic, and the U.S. Environmental Protection Agency (EPA) requires applicators to be trained and certified. This report describes a foodborne outbreak of aldicarb poisoning that occurred when improperly stored and labeled aldicarb was used mistakenly in food preparation.

Anon. *Bacillus cereus food poisoning associated with fried rice at two child day care centers--Virginia, 1993.* MMWR Morb Mortal Wkly Rep. 1994; 43(10) : 177-8.p Abstract: Bacillus cereus, an infectious cause of foodborne illness, accounted for 2% of outbreaks with confirmed etiology that were reported to CDC during 1973-1987 (1). On July 21, 1993, the Lord Fairfax (Virginia) Health District received reports of acute gastrointestinal illness that occurred among children and staff at two jointly owned child day care centers following a catered lunch. This report summarizes the investigation of this outbreak.

Anon. *Clostridium perfringens gastroenteritis associated with corned beef served at St. Patrick's Day meals--Ohio and Virginia, 1993.* MMWR Morb Mortal Wkly Rep. 1994; 43(8) : 137, 143-4.p Abstract: Clostridium perfringens is a common infectious cause of outbreaks of foodborne illness in the United States, especially outbreaks in which cooked beef is the implicated source. This report describes two outbreaks of C. perfringens gastroenteritis following St. Patrick's Day meals in Ohio and Virginia during 1993.

Anon. *Control of Salmonella infections in animals and prevention of human foodborne Salmonella infections. WHO Consultation.* Bull World Health Organ. 1994; 72(6) : 831-3.p Abstract: In many countries the incidence of human salmonella infections has markedly increased in recent years. To discuss recent developments and current understanding on the control of salmonella infections in animals, WHO organized a Consultation on the Control of Salmonella Infections in Animals: Prevention of Foodborne Salmonella Infections in Humans, held in Jena, Germany, on 21-26 November 1993. The present article summarizes the recommendations made by the participants on the pathoimmunogenesis, diagnosis, epidemiology, and control of salmonella infections and contaminations in animal production.

Anon. *Food poisoning, listeriosis, and febrile gastroenteritis.* Nutr Rev. 1997; 55(2) : 57-60.p Abstract: Outbreaks of foodborne disease owing to contamination with Listeria monocytogenes bacteria have usually been associated with the development of severe invasive disease. A recent report has provided clear documentation showing that outbreaks of L. monocytogenes also present as gastroenteritis and fever. Further studies of this foodborne organism are needed to determine its infectious dose and the characteristics of the host that are associated with noninvasive febrile gastroenteritis.

Anon. *Foodborne botulism associated with home-canned bamboo shoots--Thailand, 1998.* MMWR Morb Mortal Wkly Rep. 1999; 48(21) : 437-9.p Abstract: On April

13, 1998, the Field Epidemiology Training Program in the Thailand Ministry of Public Health (TMPH) was informed of six persons with sudden onset of cranial nerve palsies suggestive of botulism who were admitted to a provincial hospital in northern Thailand. To determine the cause of the cluster, TMPH initiated an investigation on April 14. This report summarizes the results of the investigation, which indicate that the outbreak was caused by foodborne botulism from home-canned bamboo shoots.

Anon. *Foodborne botulism from eating home-pickled eggs--Illinois, 1997.* MMWR Morb Mortal Wkly Rep. 2000; 49(34) : 778-80.p Abstract: During November 1997, the Illinois Department of Public Health was notified by a local physician about a possible case of foodborne botulism. This report summarizes the case investigation, which implicated home-pickled eggs as the cause.

Anon. *Foodborne botulism--Oklahoma, 1994.* MMWR Morb Mortal Wkly Rep. 1995; 44(11) : 200-2.p Abstract: On July 2, 1994, the Arkansas Department of Health and the Oklahoma State Department of Health were notified about a possible case of foodborne botulism. This report summarizes the investigation, which implicated consumption of improperly stored beef stew.

Anon. *Foodborne Diseases Active Surveillance Network, 1996.* MMWR Morb Mortal Wkly Rep. 1997; 46(12) : 258-61.p Abstract: As an important strategy for addressing emerging infections in the United States, in 1994 CDC began implementing Emerging Infections Programs (EIPs) in state health departments, in collaboration with local health departments, academic institutions, and organizations of health professionals. EIPs are sites that conduct special population-based surveillance projects, emphasize collaborative epidemiologic and laboratory projects, and pilot and evaluate prevention efforts. The primary foodborne diseases component of the EIP is the Foodborne Diseases Active Surveillance Network (FoodNet)--a collaborative effort among CDC, the U.S. Department of Agriculture (USDA), the Food and Drug Administration, and the EIP sites. The objectives of FoodNet are to 1) determine more precisely the burden of foodborne diseases in the United States, 2) determine the proportion of specific foodborne diseases associated with certain contaminated foods or with other exposures, and (3) provide the framework to respond rapidly and collaboratively to emerging foodborne diseases. This report summarizes preliminary results from FoodNet for 1996, which document regional and seasonal differences in the incidences of certain bacterial foodborne diseases, and presents findings of the 1995 baseline survey of clinical laboratories, which suggests that, for some pathogens, factors other than differing laboratory practices accounted for regional variations in incidences.

Anon. *Foodborne hepatitis A--Missouri, Wisconsin, and Alaska, 1990-1992.* MMWR Morb Mortal Wkly Rep. 1993; 42(27) : 526-34.p Abstract: Person-to-person spread is the predominant mode of transmission of hepatitis A virus (HAV) infection. However, based on findings for national surveillance for viral hepatitis, since 1983, 3%-8% of reported hepatitis A cases have been associated with suspected or confirmed foodborne or waterborne outbreaks (1). This report summarizes three recent foodborne outbreaks of hepatitis A and addresses the prevention of this problem.

Anon. *Foodborne nosocomial outbreak of Salmonella reading--Connecticut.* MMWR Morb Mortal Wkly Rep. 1991; 40(46) : 804-6.p Abstract: This report describes an outbreak of nosocomial salmonellosis associated with consumption of improperly thawed and cooked turkey. Although the outbreak occurred 1 year ago, this report is a timely reminder of the importance of proper cooking and handling of turkey--especially during the holiday season.

Anon. *Foodborne outbreak of cryptosporidiosis--Spokane, Washington, 1997.* MMWR Morb Mortal Wkly Rep. 1998; 47(27) : 565-7.p Abstract: On December 29, 1997, the Spokane Regional Health District received reports of acute gastroenteritis among members of a group attending a dinner banquet catered by a Spokane restaurant on December 18. The illness was characterized by a prolonged (3-9 days) incubation period and diarrhea, which led public health officials to suspect a parasitic cause of the illness. Eight of 10 stool specimens obtained from ill banquet attendees were positive for Cryptosporidium using both modified acid-fast and auramine-rhodamine staining of concentrated specimens. This report summarizes the epidemiologic investigation of the outbreak, which suggests that foodborne transmission occurred through a contaminated ingredient in multiple menu items.

Anon. *Foodborne outbreak of diarrheal illness associated with Cryptosporidium parvum--Minnesota, 1995.* MMWR Morb Mortal Wkly Rep. 1996; 45(36) : 783-4.p Abstract: On September 29, 1995, the Minnesota Department of Health (MDH) received reports of acute gastroenteritis among an estimated 50 attendees of a social event in Blue Earth County on September 16. This report summarizes the epidemiologic and laboratory investigations of the outbreak, which indicate the probable cause for this foodborne outbreak was Cryptosporidium parvum.

Anon. *Foodborne outbreak of gastroenteritis caused by Escherichia coli O157:H7--North Dakota, 1990.* MMWR Morb Mortal Wkly Rep. 1991; 40(16) : 265-7.p Abstract: In late July and early August 1990, an outbreak of gastroenteritis occurred among persons who had eaten a meal while attending an agricultural threshing show in North Dakota on July 28-29. At least 70 (3.5%) of the more than 2000 attendees were affected; of these, 16 persons were hospitalized, and two children, aged 2 and 8 years, were diagnosed with hemolytic uremic syndrome. An epidemiologic investigation was conducted by the North Dakota State Department of Health and Consolidated

Laboratories.(ABSTRACT TRUNCATED AT 250 WORDS).

Anon. *Foodborne outbreaks of enterotoxigenic Escherichia coli--Rhode Island and New Hampshire, 1993.* MMWR Morb Mortal Wkly Rep. 1994; 43(5) : 81, 87-9.p Abstract: Infections with enterotoxigenic Escherichia coli (ETEC) are a frequent cause of diarrhea in developing countries but not in the United States and other industrialized countries. This report describes two foodborne ETEC outbreaks that occurred in the United States in 1993.

Anon. *Guidelines for the control of infection with Vero cytotoxin producing Escherichia coli (VTEC). Subcommittee of the PHLS Advisory Committee on Gastrointestinal Infections.* Commun Dis Public Health. 2000; 3(1) : 14-23.p Abstract: Increasing numbers of cases of Vero cytotoxin producing Escherichia coli (VTEC) O157 infection, well published incidents, and new scientific evidence make it appropriate to produce new guidelines for their control. This document reviews the clinical and epidemiological features of VTEC O157 infection, describes the principles of microbiological investigation and laboratory safety, and presents recommendations for the prevention of spread of VTEC) O157. The recommendations consider direct spread of infection from animals, foodborne spread, the institutions in which spread is more likely to occur (nursing homes, schools, and children's day nurseries), and groups at particular risk of acquiring and transmitting infection (in essence, food handlers, and those unable to maintain high standards of hygiene for themselves and their carers).

Anon. *Incidence of foodborne illnesses--FoodNet, 1997.* MMWR Morb Mortal Wkly Rep. 1998; 47(37) : 782-6.p Abstract: Each year, millions of persons become ill from foodborne diseases, though many cases are not reported. The Foodborne Diseases Active Surveillance Network (Food-Net), the primary foodborne diseases component of CDC's Emerging Infections Program, was developed to better characterize, understand, and respond to foodborne illnesses in the United States. This report describes FoodNet surveillance data from 1997, the second year of surveillance, and compares findings with data from 1996. The findings demonstrate regional and seasonal differences in the reported incidence of certain bacterial and parasitic diseases and that substantial changes occurred in the incidence of illnesses caused by some pathogens (e.g., Vibrio and Escherichia coli O157:H7) but the overall incidence of illness caused by the seven diseases under surveillance in both years changed little.

Anon. *Incidence of foodborne illnesses: preliminary data from the Foodborne Diseases Active Surveillance Network (FoodNet)--United States, 1998.* MMWR Morb Mortal Wkly Rep. 1999; 48(9) : 189-94.p Abstract: Estimates of the magnitude of foodborne illness in the United States have been imprecise. To quantify, better understand, and more precisely monitor foodborne illness, since 1996 the Foodborne Diseases Active Surveillance Network (FoodNet) has collected data to monitor nine foodborne diseases in selected U.S. sites. This report describes preliminary data from FoodNet surveillance for 1998 and compares findings with those for 1996 and 1997; compared with 1996, the overall incidence of the foodborne illnesses under surveillance during 1998 declined, particularly for salmonellosis and campylobacteriosis, and the data continued to demonstrate regional and seasonal differences in the reported incidence of diseases.

Anon. *Microbiological safety evaluations and recommendations on sprouted seeds. National Advisory Committee on Microbiological Criteria for Foods.* Int J Food Microbiol. 1999; 52(3) : 123-53.p Abstract: In 1997, the National Advisory Committee on Microbiological Criteria for Foods (NACMCF/the Committee) was asked to review the current literature on sprout-associated outbreaks: identify the organisms and production practices of greatest public health concern: prioritize research needs: and provide recommendations on intervention and prevention strategies. In response to this charge, the Fresh Produce Work Group (FPWG) documented the relevant epidemiology and microbial ecology of sprout-associated outbreaks and reviewed current industry practices and initiatives related to the growing of seed and the production of sprouts. Sprouts have been identified as a special problem because of the potential for pathogen growth during the sprouting process. If pathogens are present on or in the seed, sprouting conditions may favor their proliferation. There is no inherent step in the production of raw sprouts to reduce or eliminate pathogens. Contaminated seed is the likely source for most reported sprout-associated outbreaks. Research has been initiated on methods to reduce or eliminate pathogenic bacteria on seeds and sprouts and some treatments show promise. However, to date, no single treatment has been shown to completely eliminate pathogens under experimental conditions used. Finally, the Committee found that, at the time of the charge, there was a lack of fundamental food safety knowledge along the continuum from seed production through sprout consumption. More recently, many have become aware of the potential for this food to be a vehicle for foodborne illness and the need for appropriate controls: however, such awareness is not universal. Although seed appears to be the most likely source of contamination in sprout associated outbreaks, practices and conditions at the sprouting facility may also impact on the safety of the finished product. In recent sprout-associated outbreak investigations, facilities associated with outbreaks did not consistently apply seed disinfection treatments prior to sprouting. Conversely, facilities that used seed from the same lot as an implicated facility, but had not been associated with reported illnesses, appear to have been consistently using seed disinfection treatments, such as 20,000 ppm calcium hypochlorite, to disinfect seed prior to sprouting. The Committee has developed a number of specific recommendations, including: 1. The knowledge of all interested parties pertaining to the microbiological safety of sprouted seeds must be enhanced; government and industry should develop education programs for seed and sprout producers

on basic principles for microbiological food safety, good agricultural practices, good manufacturing practices, and hazard analysis and critical control point (HACCP) systems. 2. Good agricultural practices should be systematically implemented to reduce the potential for microbial contamination of seeds for sprout production. 3. Seed cleaning, storage, and handling practices that minimize the potential for microbial contamination should be developed and implemented. 4. Seeds should be treated with one or more treatments that have been shown to reduce pathogenic bacteria that may be present. Intervention strategies that deliver less than a given reduction (at this time, 5-log) in levels of Salmonella spp. and enterohemorrhagic Escherichia coli O157 should be coupled with a microbiological testing program. 5. Establish good manufacturing practices and food safety systems, including regulatory oversight, microbial testing, adoption of HACCP, and improved traceback, that systematically look for means to prevent seeds from serving as the vehicle for foodborne disease, and 6. Conduct research related to the microbiological safety of sprouted seeds, particularly in the areas of pathogen reduction or elimination, sources of contamination and its prevention, and preventing or retarding pathogen growth during sprouting.

Anon. *Outbreaks of Norwalk-like viral gastroenteritis--Alaska and Wisconsin, 1999.* MMWR Morb Mortal Wkly Rep. 2000; 49(10) : 207-11.p Abstract: Norwalk-like viruses (NLVs) are the most common cause of epidemic gastroenteritis in the United States, resulting in illness in approximately 23 million persons each year . Persons of all ages are affected because previous infection confers only short-term immunity. Most NLV gastroenteritis outbreaks involve foodborne or person-to-person transmission. This report presents investigations of a foodborne NLV outbreak in Alaska and person-to-person transmission in Wisconsin.

Anon. *Outbreaks of Salmonella enteritidis gastroenteritis--California, 1993.* MMWR Morb Mortal Wkly Rep. 1993; 42(41) : 793-7.p Abstract: Foodborne infections cause an estimated 6.5 million cases of human illness and 9000 deaths annually in the United States. Salmonella is the most commonly reported cause of foodborne outbreaks, accounting for 28% of such outbreaks of known etiology and 45% of outbreak-associated cases during 1973-1987. During 1985-1992, state and territorial health departments reported 437 Salmonella enteritidis (SE) outbreaks (Table 1), which accounted for 15,162 cases of illness, 1734 hospitalizations, and 53 deaths. This report describes three SE outbreaks in California during a 4-month period in 1993.

Anon. *Paralytic shellfish poisoning--Massachusetts and Alaska, 1990.* MMWR Morb Mortal Wkly Rep. 1991; 40(10) : 157-61.p Abstract: Paralytic shellfish poisoning (PSP) is a foodborne illness caused by consumption of shellfish or broth from cooked shellfish that contain either concentrated saxitoxin, an alkaloid neurotoxin, or related compounds. This report summarizes outbreaks of PSP that occurred in Massachusetts and Alaska in June 1990.

Anon. *Preliminary FoodNet data on the incidence of foodborne illnesses--selected sites, United States, 1999.* MMWR Morb Mortal Wkly Rep. 2000; 49(10) : 201-5.p Abstract: Each year in the United States, an estimated 76 million persons experience foodborne illnesses. CDC's Emerging Infections Program Foodborne Diseases Active Surveillance Network (FoodNet) collects data on nine foodborne diseases in selected U.S. sites to quantify and monitor foodborne illnesses. This report describes preliminary surveillance data for 1999 and compares them with data from 1996-1998. The data suggest that the incidence of the foodborne illnesses under surveillance declined during 1999 compared with 1996 primarily as a result of decreases in campylobacteriosis and shigellosis and indicate substantial regional variation in the incidence of foodborne diseases.

Anon. *Update: foodborne listeriosis--United States, 1988-1990.* MMWR Morb Mortal Wkly Rep. 1992; 41(15) : 251, 257-8.p Abstract: Although outbreaks of invasive disease caused by Listeria monocytogenes have been associated with ingestion of a variety of contaminated foods (1-5), most listeriosis in the United States occurs as isolated or sporadic cases. To determine the incidence of listeriosis and identify risk factors for disease, during 1988-1990, CDC collaborated with investigators in four states to conduct active laboratory-based surveillance and special studies in a population of more than 18 million U.S. residents. This report summarizes the findings of these studies (6,7).

Anon. *Vibrio vulnificus infections associated with eating raw oysters--Los Angeles, 1996.* MMWR Morb Mortal Wkly Rep. 1996; 45(29) : 621-4.p Abstract: Of all foodborne infectious diseases, infection with Vibrio vulnificus is one of the most severe; the case-fatality rate for V. vulnificus septicemia exceeds 50%. In immunocompromised hosts V. vulnificus infection can cause fever, nausea, myalgia, and abdominal cramps 24-48 hours after eating contaminated food; because the organism can cross the intestinal mucosa rapidly, sepsis and cutaneous bullae can occur within 36 hours of the initial onset of symptoms. Cases are most commonly reported during warm-weather months (April-November) and often are associated with eating raw oysters. During April 1993-May 1996, a total of 16 cases of V. vulnificus infection were reported in Los Angeles county. Fifteen (94%) of these patients were primarily Spanish-speaking, 12 (75%) had preexisting liver disease (associated with alcohol use or viral hepatitis), all were septicemic, and all had eaten raw oysters 1-2 days before onset of symptoms. In May 1996, three deaths related to V. vulnificus infection among primarily Spanish-speaking persons were reported to the Los Angeles County Department of Health Services (LACDHS). This report summarizes the findings of the investigations of these fatal cases and illustrates the importance of prevention strategies for persons with preexisting liver disease.

Anon. *Viral gastroenteritis associated with consumption of raw oysters--Florida, 1993.* MMWR Morb Mortal Wkly Rep. 1994; 43(24) : 446-9.p Abstract: During November 20-30, 1993, four county public health units (CPHUs) of the Florida Department of Health and Rehabilitative Services (HRS) in northwestern Florida conducted preliminary investigations of seven separate outbreaks of foodborne illness following consumption of raw oysters. On December 1, the HRS State Health Office initiated an investigation to characterize the illness, examine risk factors for oyster-associated gastroenteritis, and quantify the dose-response relation. This report presents the findings of these two investigations.

Appendini P. et al. *Antimicrobial activity of a 14-residue synthetic peptide against foodborne microorganisms.* J Food Prot. 2000; 63(7) : 889-93.p Abstract: A chemically synthesized short-chain peptide composed of six leucine and eight lysine (6K8L) residues was demonstrated to be biocidal against several foodborne organisms including Escherichia coli O157:H7, Listeria monocytogenes, Pseudomonas fluorescens, and Kluyveromyces marxianus suspended in phosphate buffer at concentrations of 5 to 50 microg/ml. All strains were reduced by 3 log10 CFU/ml within 10 min at peptide concentrations of <10 microg/ml. The peptide reduced by 3 log10 CFU/ml E. coli O157:H7 counts in apple juice and was active over the pH range of 3.5 to 7. Peptide concentrations of 100 microg/ml inhibited the aerobic and anaerobic microorganisms present in meat exudate liquid. However, the peptide was not effective against E. coli O157:H7 in skim milk at concentrations up to 100 microg/ml.

Arizcun C. et al. *Effect of several decontamination procedures on Listeria monocytogenes growing in biofilms.* J Food Prot. 1998; 61(6) : 731-4.p Abstract: Listeria monocytogenes is a pathogenic bacterium which has been implicated in several foodborne illnesses. This microorganism grows into biofilms attached to the surfaces in food-processing plants, increasing its resistance to antimicrobial agents. The present work was realized to investigate the attachment of L. monocytogenes isolates to glass surfaces and to find a decontamination procedure to remove these bacteria in biofilms. Three-day biofilms were prepared by growing L. monocytogenes isolates from food plant environments on glass surfaces. Sixteen decontamination treatments at different pHs, temperatures, and times of exposure were tested against L. monocytogenes biofilms. The most efficient treatments were those applied at 63 degrees C. Combinations of decontamination treatments applied at 55 degrees C for 30 min provided different results according to the other factors used. In general, L. monocytogenes biofilms were found to be not very susceptible to high osmolarity (10.5% NaCl), and the interaction of sodium chloride and acid did not seem to have important effects in inactivating these bacteria (from a 1.3-to a 1.9-log-CFU/cm2 reduction). The combination of NaOH (pH 10.5; 100 mM) and acetic acid (pH 5.4; 76.7 mM) applied sequentially at 55 degrees C for even 5 min was shown to be the most effective treatment to remove L. monocytogenes from biofilms (at least a 4.5-to 5.0-log-CFU/cm2 decline).

Armstrong G.L. et al. *Emerging foodborne pathogens: Escherichia coli O157:H7 as a model of entry of a new pathogen into the food supply of the developed world.* Epidemiol Rev. 1996; 18(1) : 29-51.p Abstract: There would appear to be little argument that the large outbreaks of E. coli O157:H7 which have occurred since the early 1980s represent a distinct, new phenomenon. The number of reported cases have increased dramatically, starting from zero in 1981; however, it is also clear that this increase in reported cases is in part an artifact of improved surveillance and reporting. Available data suggest that E. coli O157:H7 infections were present prior to 1982, although numbers appear to have been small. At a molecular level, the organism shows evidence of clonal origin, but there is not the striking clonality, with virtually identical pulsed-field gel electrophoresis and ribotyping patterns, which has been seen in situations such as the emergence of Vibrio cholerae O139 Bengal in the Indian subcontinent in 1992 or the introduction of V. cholerae O1 into naive populations in South America in 1991 (127-129). Findings are more consistent with the image of an organism which arose from a common ancestor, but which has had time to become distributed geographically and to show some evidence of genetic divergence. While this is an "emerging" infection, at least in terms of its distribution and public recognition, it is unlikely that it will be possible to identify the "first" O157:H7 case or to track the clonal spread of the organism through cattle or human populations.

Arnedo A. et al. *[Epidemic outbreaks of salmonellosis caused by eating eggs].* Enferm Infecc Microbiol Clin. 1998; 16(9) : 408-12.p Abstract: BACKGROUND: Investigation of outbreaks of foodborne infections (OFI) by Salmonella associated with the consumption of hens' eggs from a same classification center of Castellon, and determination of origin, extension and to take measures of control and prevention. METHODS: Descriptive and case-control studies, microbiologic analysis of feces, suspicious foods, and eggs. Sampling of eggs in the classification center for estimation the prevalence of Salmonlla. RESULTS: In 1992, 5 OFI were detected, 4 collective (1 school, 2 restaurants, and 1 residence) and 1 at home, by the consumption of food prepared with eggs: fried or boiled eggs, omelette, souffle, 2 times, and home-made russian salad. Five hundred and forty-five persons were exposed and 364 were studied, with 100 case patients and 16 hospitalized. The range of attack rates was 10.5-87.0%. Samonella enteritidis (3 OFI) and S. typhimurium (3 OFI) were the infectious agents. In February 1993, the prevalence of Salmonella in eggs from the center was 0.26% (4/1.524) (S. enteritidis, 2 isolates, and S. typhimurium, 2 isolate), three on the shell, and one in the yolk. Two farmhouses of the six supplied were infected. CONCLUSIONS: These outbreaks indicate that salmonellosis by egg's consumption are frequent here and investigation of infection sources is necessary.

Arnedo Pena A. et al. *[Food poisoning outbreak probably of viral etiology caused by Norwalk virus]*. Gac Sanit. 1991; 5(25) : 169-73.p Abstract: In May 1989, a foodborne outbreak of acute gastroenteritis was identified in a state school in Adzaneta, Castellon. A dtudy was undertaken to describe it, investigate its causes, and recommend adequate control measures. Sixteen children and 2 teachers were affected (attack rate: 28.57%). Kaplan and cols clinical and epidemiological criteria for Norwalk-like virus as the responsible agent were present. The probable origin of the outbreak was a foodhandler who was already ill beforehand. The examination of stools of the foodhandler and a patient showed small round structures similar to the Norwalk virus. In Spain, the number of foodborne outbreaks without known causal agent has steadily increased in recent years. It may be that this microorganism is responsible for some of these outbreaks in which, for several reasons, the causal agent cannot be identified.

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Babu S. et al. *Health & nutritional implications of food colours.* Indian J Med Res. 1995; 102 : 245-9.p Abstract: Colour is a vital constituent of food which imparts distinct appearance to the food product. Artificial colouring becomes a technological necessity as foods tend to lose their natural shade during processing and storage. Most of the food colours tested in the conventional toxicity experiments showed toxic effects at a very high level of intake i.e., 1-5 per cent in the diet. However, such levels of intake are not normally encountered. Human studies indicated that food colours, (natural or synthetic) can induce wide range of allergic reactions only in sensitive or atopic individuals. Most of the foodborne diseases reported are due to the consumption of non-permitted textile colours or abuse of colours. The Government is pressurised periodically to place a total ban on the use of food colours due to their possible ill effects. It should be realised that surveillance should go hand in hand with legal actions.

Backer H.D. et al. *High incidence of extra-intestinal infections in a Salmonella Havana outbreak associated with alfalfa sprouts.* Public Health Rep. 2000; 115(4) : 339-45.p Abstract: OBJECTIVE: To determine a vehicle and point source for an outbreak of Salmonella Havana. METHODS: The authors conducted a case-control study and traceback investigation of 14 residents of California and four from Arizona with onsets of illness from Apr 15, 1998, to June 15, 1998, and Salmonella Havana infections with identical PFGE patterns. RESULTS: Seventeen of 18 patients were women. Seventeen were adults 20-89 years of age. Nine (50%) had diarrheal illness, 6 (33%) had urinary tract nfections, 2 (11%) had sepsis, and one had an infected surgical wound after appendectomy. Four patients were hospitalized, and one died. Eating alfalfa sprouts was associated wth S. Havana infection (OR = 10.0; 95% confidence interval 1.2, 83.1; P = 0.01). CONCLUSIONS: This outbreak resulted in a high incidence of extra-intestinal infections, especially urinary tract infections, and high morbidity. Raw alfalfa sprouts, often considered a safe "heath food," can be a source of serious foodborne disease outbreaks.

Baljer G. et al. *[Animals as a source of infections for humans--diseases caused by EHEC]*. DTW Dtsch Tierarztl Wochenschr. 1999; 106(8) : 339-43.p Abstract: EHEC (enterohaemorrhagic E. coli) bacteria are new, only since 1982 recognized zoonotic pathogens. EHEC differ from E. coli intestinal commensales by the fact that they are lysogenic infected with bacteriophages, which carry the genetic information for the production of shigatoxins (Stx type 1 and/or 2). Due to the obligatory released Stx EHEC are classified also among the Shigatoxin producing E. coli (STEC). EHEC are capable of causing a Hemorrhagic Colitis and some sequelae of diseases such as the haemolytic uraemic syndrome. Due to their virulence factors they can be divided into typical and non-typical EHEC. Typical EHEC possess a pathogenicity island (Locus of Enterocyte Effacement) harboring genes, which apart from the characteristic necrotic activity of Stx enable the pathogens to closely attach to the epithelial cells of the intestinal mucosa and to destruct the microvilli. Additionally a so-called virulence plasmid codes for the production of a haemolysin, a peroxidase-katalase, an enterotoxin as well as a serine protease. EHEC are one of the world-wide most important causes of foodborne infections. Depending upon the country, most of the incidences in 1998 varied between 1 to 3 cases per 100,000 inhabitants. Since EHEC are only notifiable in a few countries, one must count however on substantially higher numbers. In Germany the estimated incidence is about 13 cases per 100,000 inhabitants. Since the first EHEC outbreaks were recognized in humans, studies investigating the prevalence of EHEC within animals were repeatedly performed. From the outset one assumed that cattle are a possible reservoir. Actually EHEC were isolated from fecal samples world-wide (typical and non-typical EHEC) from a large percentage of cattle (> 50%). Besides EHEC were isolated sporadically from fecal samples of other animals and healthy humans. The EHEC bacteria are shed by infected humans and animals, in particular by infected ruminants. They are spread over manure, slurry, sewage etc. Humans can get infected directly by contact with infected persons or animals or indirectly by contaminated food, water etc. The clinical outcome within humans appears as aqueous to bloody diarrhea. Beyond that approximately 5 to 10% of the patients develop the haemolytic uraemic syndrome. In contrast to humans, animals are mostly infected clinically inapparent. The therapy is based upon a symptomatic treatment. At present in man the control of EHEC infections concentrates on a particularly strict hand hygiene after the contact with infected humans and animals (above all ruminants). Since EHEC are heat sensitive, the prophylaxis by sufficient heating of risk food (raw milk, ground beef) is of special importance. In veterinary medicine above all EHEC infections must be controlled in ruminants, which are the primary reservoir. Due to the wide spread of EHEC in the ruminant population it is not realistic to demand an EHEC free cattle stock. Since EHEC are spread only via fecal excretion, at present it is most important to reduce the fecal

shedding and to avoid fecal contamination of food of animal origin. In detail prophylactic hygienic measures concerning the farm management, the feeding hygiene, the food hygiene, the meat hygiene as well as the food hygiene are available.

Banatvala N. et al. *Meat grinders and molecular epidemiology: two supermarket outbreaks of Escherichia coli O157:H7 infection.* J Infect Dis. 1996; 173(2) : 480-3.p Abstract: Between 23 June and 15 July 1994, 21 cases (19 primary and 2 secondary) of Escherichia coli O157:H7 infection were identified in the Bethel, Connecticut, area. Three pulsed-field gel electrophoresis (PFGE) patterns from 15 isolates (I, n = 13; II, n = 2; and III, n = 1) were observed. A case-control study that excluded secondary cases and patients with PFGE II and III patterns (n = 16) demonstrated that consumption of food from one supermarket was associated with illness (15/16 cases vs. 31/47 geographically matched controls, odds ratio [OR] undefined, lower 95% confidence interval OR = 1.45, P = .018). No one food was associated with illness. Inspection of the supermarket revealed deficiencies in hygiene and meat handling practices. The 2 cases with PFGE II ate raw beef and raw lamb from a second supermarket. These outbreaks demonstrate the value of PFGE in supporting epidemiologic investigations and the potential for outbreaks arising from retail outlets.

Barefoot S.F. et al. *Antibiosis revisited: bacteriocins produced by dairy starter cultures.* J Dairy Sci. 1993; 76(8) : 2366-79.p Abstract: Well before the existence of starter bacteria was recognized, their activities were instrumental in preserving dairy foods. During growth in fermented products, dairy starters, including lactobacilli, lactococci, leuconostocs, streptococci, and propionibacteria, produce inhibitory metabolites. Inhibitors include broad-spectrum antagonists, organic acids, diacetyl, and hydrogen peroxide. Some starters also produce bacteriocins or bactericidal proteins active against species that usually are related closely to the producer culture. Several bacteriocins have been biochemically and genetically characterized. Evaluating properties of the Lactobacillus acidophilus bacteriocin, lactacin B, led to a new purification protocol. Purified lactacin B migrates in SDS-PAGE as a single 8100-Da band with inhibitory activity after Coomassie blue staining. Production of lactacin B is enhanced by cultivation of the producer with the sensitive indicator, Lactobacillus delbrueckii ssp. lactis 4797; understanding this interaction may increase knowledge of production of bacteriocins in heterogeneous cultures. Bacteriocins have been recently identified in dairy propionibacteria. Jenseniin G, a bacteriocin produced by Propionibacterium jensenii P126, has narrow activity; propionicin PLG-1 produced by Propionibacterium thoenii P127 inhibits propionibacteria, some fungi, Campylobacter jejuni, and additional pathogens. Better understanding of these antagonists may lead to targeted biocontrol of spoilage flora and foodborne pathogens.

Barnard N.D. et al. *The medical costs attributable to meat consumption.* Prev Med. 1995; 24(6) : 646-55.p Abstract: OBJECTIVE. To estimate the medical costs that are attributable to the health effects of meat consumption. METHODS. The prevalence of hypertension, heart disease, cancer, diabetes, gallstones, obesity, and foodborne illness among omnivores and vegetarians are compared in studies that have controlled for other lifestyle factors, and the corresponding attributable medical costs are calculated in 1992 dollars. RESULTS. Direct health care costs attributable to meat consumption are estimated to be +2.8-8.5 billion for hypertension, +9.5 billion for heart disease, +0-16.5 billion for cancer, +14.0-17.1 billion for diabetes, +0.2-2.4 billion for gallbladder disease, +1.9 billion for obesity-related musculoskeletal disorders, and +0.2-5.5 billion for foodborne illness. The total direct medical costs attributable to meat consumption for 1992 are estimated at +28.6-61.4 billion. CONCLUSION. Health care costs attributable to meat consumption are quantifiable and substantial.

Barnhart E.T. et al. *Evaluation of potential disinfectants for preslaughter broiler crop decontamination.* Poult Sci. 1999; 78(1) : 32-7.p Abstract: The broiler crop has recently been implicated as a major source of Salmonella contamination at commercial processing. Furthermore, feed withdrawal has been positively correlated with increased Salmonella incidence in the crop, probably due to coprophagy. In the present study, a rapid screening assay was developed to evaluate several potential disinfectants in the presence of large quantities of organic matter, simulating the crop environment. An apparent synergistic combination of d-Limonene (DL) and citric acid (CA) was observed when evaluating the potential to eliminate Salmonella in the presence of organic material. A method of encapsulation of DL and CA was developed for voluntary consumption by broilers during feed withdrawal. During an 8-h feed withdrawal individual 8-wk-old broilers voluntarily consumed an average of 21.5 capsules (total of 3.44 g material). When eight capsules were force-administered to Salmonella-challenged 8-wk-old broilers during an abbreviated 4 h feed withdrawal, Salmonella was not recovered using selective enrichment. To evaluate the effect of voluntary capsule consumption, 8-wk-old broilers were challenged with 1 x 108 cfu of Salmonella 5 d prior to an 8 h feed withdrawal. When these broilers were allowed unlimited continuous access to capsules containing DL/CA during an 8 h feed withdrawal, 24.8 capsules per broiler were ingested without affecting Salmonella recovery from crops. When access to capsules containing DL/CA was limited to the final 45 min of an 8 h feed withdrawal in a similar experiment, an average of 22.2 capsules were consumed by each broiler, resulting in a significant decrease in the number of Salmonella-positive crops. Although a number of practical questions and considerations remain, these data suggest that appropriate disinfectants could be administered during preslaughter feed withdrawal for the purpose of reducing foodborne pathogens in crops.

Barrett T.J. et al. *Laboratory investigation of a multistate food-borne outbreak of Escherichia coli O157:H7 by using pulsed-field gel electrophoresis and phage typing.* J Clin Microbiol. 1994; 32(12) : 3013-7.p Abstract: Two hundred thirty-three isolates of Escherichia coli O157:H7 were analyzed by both pulsed-field gel electrophoresis (PFGE) and bacteriophage typing. All 26 isolates from persons whose illness was associated with a recent multistate outbreak of E. coli O157:H7 infections linked to the consumption of undercooked hamburgers and all 27 isolates from incriminated lots of hamburger meat had the same phage type and the same PFGE pattern. Twenty-five of 74 E. coli O157:H7 isolates from Washington State and 10 of 27 isolates from other states obtained during the 6 months before the outbreak had the same phage type as the outbreak strain, but only 1 isolate had the same PFGE pattern. PFGE thus appeared to be a more sensitive method than bacteriophage typing for distinguishing outbreak and non-outbreak-related strains. The PFGE patterns of seven preoutbreak sporadic isolates and five sporadic isolates from the outbreak period differed from that of the outbreak strain by a single band, making it difficult to identify these isolates as outbreak or non-outbreak related. Phage typing and PFGE with additional enzymes were helpful in resolving this problem. While not as sensitive as PFGE, phage typing was helpful in interpreting PFGE data and could have been used as a simple, rapid screen to eliminate the need for performing PFGE on unrelated isolates.

Bayles D.O. et al. *Osmoprotectants and cryoprotectants for Listeria monocytogenes.* Lett Appl Microbiol. 2000; 30(1) : 23-7.p Abstract: Listeria monocytogenes is a foodborne pathogen that can grow in high osmotic strength environments and at refrigeration temperatures. Glycine betaine, proline betaine, acetylcarnitine, carnitine, gamma-butyrobetaine and 3-dimethylsulphoniopropionate all acted as osmoprotectants, as evidenced by an increase in growth rate of L. monocytogenes 10403S and Scott A when provided with these compounds, while being stressed in defined medium containing 0.7 M NaCl. These same compounds exhibited cryoprotective activity, as evidenced by increasing the growth rate of L. monocytogenes at 5 degrees C. Ectoine, hydroxy ectoine, pipecolic acid and proline were ineffective as osmoprotectants or cryoprotectants under these conditions. The presence of osmoprotectants and cryoprotectants in foods may provide compounds assisting L. monocytogenes to overcome the barriers of high osmotic strength and low temperature that otherwise control microbial growth.

Bean N.H. et al. *Surveillance for foodborne-disease outbreaks--United States, 1988-1992.* Mor Mortal Wkly Rep CDC Surveill Summ. 1996; 45(5) : 1-66.p Abstract: PROBLEM/CONDITION: Since 1973, CDC has maintained a collaborative surveillance program for collection and periodic reporting of data concerning the occurrence and causes of foodborne-disease outbreaks (FBDOs). REPORTING PERIOD COVERED: This summary reviews data from January 1988 through December 1992. DESCRIPTION OF SYSTEM: The surveillance system reviews data concerning FBDOs--defined as the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food. Before 1992, only one case of intoxication by chemical, marine toxin, or Clostridium botulinum toxin as a result of the ingestion of food was required to constitute an FBDO. Since 1992, two or more cases have been required. State and local public health departments have primary responsibility for the identifying and investigating FBDOs. State and territorial health departments report these outbreaks to CDC on a standard form. RESULTS: During 1988-1992, a total of 2,423 outbreaks of foodborne disease were reported (451 in 1988, 505 in 1989, 532 in 1990, 528 in 1991, and 407 in 1992). These outbreaks caused a reported 77,373 persons to become ill. Among outbreaks for which the etiology was determined, bacterial pathogens caused the largest percentage of outbreaks (79%) and the largest percentage of cases (90%). Salmonella serotype Enteritidis accounted for the largest number of outbreaks, cases, and deaths; most of these outbreaks were attributed to eating undercooked, infected eggs. Chemical agents caused 14% of outbreaks and 2% of cases; parasites, 2% of outbreaks and 1% of cases; and viruses, 4% of outbreaks and 6% of cases. INTERPRETATION: The number of FBDOs reported per year did not change substantially during the first 4 years but declined in 1992 as a result of the revised definition of an outbreak. During this reporting period, S. Enteritidis continued to be a major cause of morbidity and mortality. In addition, multistate outbreaks caused by contaminated produce and outbreaks caused by Escherichia coli O157:H7 became more prominent. ACTIONS TAKEN: State and local public health departments investigate FBDOs. At the regional and national level, surveillance data provide an indication of the etiologic agents, vehicles of transmission, and contributing factors associated with FBDOs and help direct public health actions.

Bean N.H. et al. *Foodborne disease outbreaks, 5-year summary, 1983-1987.* Mor Mortal Wkly Rep CDC Surveill Summ. 1990; 39(1) : 15-57.p Abstract: This report summarizes data from foodborne disease outbreaks reported to CDC from 1983 through 1987. With a few exceptions, an outbreak is defined as an incident in which two or more persons experience a similar illness and food is implicated. During this period, 2,397 outbreaks of foodborne disease were reported, representing 91,678 cases. Among outbreaks in which the etiology was determined, bacterial pathogens caused the largest number of outbreaks (66%) and cases (92%). Chemical agents caused 26% of outbreaks and 2% of cases. Parasites caused 4% of outbreaks and less than 1% of cases, and viruses caused 5% of outbreaks and 5% of cases. The discrepancies between the number of outbreaks and the number of cases attributed to each etiologic agent emphasizes the importance of evaluating both numbers before drawing conclusions. The etiologic agent was not determined in 62% of outbreaks, reflecting the need for improved investigative skills. The number of outbreaks reported by this surveillance system is only a small fraction of the true number that occur. The likelihood of an outbreak's being reported depends on many factors, such as

ease of recognition and ease of laboratory confirmation. Sporadic foodborne illness is far more common and is not included in this report.

Bean N.H. et al. *Crayfish: a newly recognized vehicle for vibrio infections.* Epidemiol Infect. 1998; 121(2) : 269-73.p Abstract: We conducted a 1-year case-control study of sporadic vibrio infections to identify risk factors related to consumption of seafood products in two coastal areas of Louisiana and Texas. Twenty-six persons with sporadic vibrio infections and 77 matched controls were enrolled. Multivariate analysis revealed that crayfish ($P < 0.025$) and raw oysters ($P < 0.009$) were independently associated with illness. Species-specific analysis revealed an association between consumption of cooked crayfish and Vibrio parahemolyticus infection (OR 9.24, $P < 0.05$). No crayfish consumption was reported by persons with V. vulnificus infection. Although crayfish had been suspected as a vehicle for foodborne disease, this is the first time to our knowledge that consumption of cooked crayfish has been demonstrated to be associated with vibrio infection.

Becker B. et al. *[Transmission of pathogenic human viruses by foods: hepatitis A epidemic caused by baked goods in the Euskirchen district)]*. Gesundheitswesen. 1996; 58(6) : 339-40.p Abstract: In the last few years many reports have documented that human pathogenic viruses are transmitted via food and can cause epidemics. Between November 1994 and February 1995 a HAV epidemic was recorded in the village and agricultural area of Euskirchen (Germany). 49 persons with HAV infections were registered. It seems that the epidemic started in a bakery and was caused by an employee who had spent his holidays in the Dominican Republic and came back already excreting the virus via his faeces. Two weeks later he developed a symptomatic illness. HAV is transmitted via a fecal-oral cycle. Lack of hygiene in food production and distribution cause the risk of secondary virus contamination. Virus transmission via food is first of all a problem in uncooked food. To ensure success in food safety in respect of foodborne human pathogenic viruses it is important to establish personal hygienic education, cleaning and disinfection plans and preventive measures such as immunization to avoid viruses in the food.

Bellido Blasco J.B. et al. *[Factors associated with sporadic cases of salmonellosis in 1- to 7-year-old children. Study of cases and controls]*. Gac Sanit. 1998; 12(3) : 118-25.p Abstract: BACKGROUND: Knowledge about salmonellosis risk factors mainly comes from foodborne outbreaks, and we know little about sporadic cases epidemiology. However most of the cases are sporadic, specially children. This study aims to find out some of determinants of these cases. METHODS: A case-control study with incident cases and controls from the same base population (laboratory diagnosed cases). Cases were children 1-7 years old, affected by diarrhea with culture stools positive to Salmonella between december 1994 and december 1995. Controls from the same source, but positive culture to Campylobacter or viruses. We study food and other environmental risk factors. Odds ratio (OR) are calculated adjusted for age, sex, and year period (cool and cold) by logistic regression. RESULTS: Eating minced meat during three days before symptoms, OR 4.07 (1.20-13.8) and OR 5.63 (1.34-23.6); pets, OR 8.27 (1.96-34.9), and antibiotics the week before symptoms, OR 4.75 (0.84-27.0) were epidemiologically associated with salmonellosis diarrhea. CONCLUSIONS: Epidemiology of salmonellosis sporadic cases in children seems different to the foodborne associated cases and is more complex. Minced meat tree days before symptoms, antibiotics the week before symptoms, and pets could be a risk for this kind of cases. Future studies must also take account of this factors.

Bellido Blasco J.B. et al. *[Outbreak of Salmonella enteritidis food poisoning. Potential protective effect of alcoholic beverages (see comments)]*. Med Clin (Barc). 1996; 107(17) : 641-4.p Abstract: BACKGROUND: On may 1994, a foodborne outbreak took place in Almazora (Castellon, Spain) after a meal with 116 persons. A sanitary study was made to find out the causes and control the outbreak. SUBJECTS AND METHODS: Inspection of the setting and a case-control study were carried out. Several foods and faecal specimens of 23 patients were investigated. We also study the effect of alcohol on the occurrence of the outbreak. RESULTS: A hundred people was interviewed (86%), 58 ill persons. Salmonella enteritidis was isolated from faeces and statistically implicated food (odds ratio = 75, IC 95 = 15.6-361), a sandwich with tuna, boiled eggs and vegetables. Among adults, epidemiological analysis showed a protective effect of alcohol, adjusted for age, sex and consumption of the implicated food ($p = 0.007$). CONCLUSIONS: In the study of foddborne outbreaks by Salmonella enteritidis simultaneous consumption of alcoholic drinks and foods should be taken into account to explain some exposed non-cases.

Bengis R.G. *Animal health risks associated with the transportation and utilisation of wildlife products.* Rev Sci Tech. 1997; 16(1) : 104-10.p Abstract: The animal health risks associated with the movement of wildlife products are infinitely less than those associated with the movement of live animals. Very few pathogens are sufficiently robust to survive the significant changes in temperature, pH, moisture content and osmolality which occur post mortem, or which are associated with preservation processes such as pickling, smoking or drying. Certain pathogens, however, (e.g. foot and mouth disease, classical swine fever [hog cholera] and African swine fever viruses and the anthrax bacillus) are hardy and resistant to these environmental changes and therefore constitute a finite animal health risk if raw, undercooked or under-preserved products from infected wild animals are imported. Other less robust pathogens, such as rinderpest virus, may remain infectious in animal products if these are obtained from acutely infected animals and frozen immediately. Macroparasitic diseases such as trichinellosis and echinococcosis-hydatidosis, if present in the

unprocessed tissues of infected wildlife, are potentially infectious to carnivorous or omnivorous companion animals. The importation of untreated wet hides may result in the introduction of alien ectoparasites and/or the infectious diseases for which they are vectors. The author discusses the more significant pathogens found in free-ranging wildlife which should be taken into consideration when importing wildlife products from endemically or epidemically infected countries.

Bennett A.R. et al. *The isolation and detection of Escherichia coli O157 by use of immunomagnetic separation and immunoassay procedures.* Lett Appl Microbiol. 1996; 22(3) : 237-43.p Abstract: The use of immunomagnetic separation (IMS) techniques has been reported to reduce the total test time, and improve the sensitivity, of microbiological tests done on foods. This approach is being adopted in epidemiological investigations into suspected foodborne outbreaks of Escherichia coli O157 infection and has gained acceptance by public health laboratories and the food industry. This study demonstrated the ability of a commercially available IMS procedure, Dynabeads anti-E. coli O157, to enable detection of a few cells of E. coli O157 in 25 g of inoculated minced beef, giving results 1 d earlier than a cultural analysis of similar sensitivity. With correct choice of enrichment broths, IMS may increase isolation rate of E. coli O157 compared to that obtained using conventional cultural methods. It is suggested that this may be due to an increase in relative concentration of E. coli O157 compared with the background microflora present in minced beef, which may reduce reliability of non-IMS detection procedures by masking or mimicking target cells on selective/differential solid media. The use of an immunoassay incorporating an IMS step, EHEC-Tek (Organon-Teknika), enabled detection of a few cells of E. coli O157 in 25 g of minced beef. Comparison of the IMS-ELISA with a standard ELISA procedure (Tecra) indicated the sensitivity of the latter system to be greater, perhaps resulting in the higher isolation rate. The use of a method to reliability isolate and detect extremely low levels of E. coli O157 in a food is necessary to aid reduction in the incidence of this most serious of foodborne pathogens.

Bentley C.A. et al. *Phage typing and drug resistance of Shigella sonnei isolated in England and Wales.* Epidemiol Infect. 1996; 116(3) : 295-302.p Abstract: Phage typing of Shigella sonnei has been used to examine isolates from the 1991-2 sonnei dysentery outbreak in England and Wales and compare them with strains isolated during and following a widespread foodborne outbreak in 1994 which was associated with consumption of imported lettuce. The distribution of phage types was different in the three periods studied with PT 3 predominating during 1991-2, PT 2 during the 'lettuce' outbreak in the summer months and PT 6 during the subsequent months. PT 6 was frequently associated with travel outside the UK. Variation was also seen in the distribution of drug resistance patterns.

Bercion R. et al. *[Clinical and biological aspects of a collective alimentary toxi- infection by group A streptococcus in a military unit stationed in Djibouti].* Bull Soc Pathol Exot. 1993; 86(1) : 29-34.p Abstract: An outbreak of streptococcal pharyngitis due to a group A beta-hemolytic streptococcus has occurred in a French Army unit based in Djibouti during the month of september 1991. Out of 304 sick soldiers, 73% were seen by a physician in the initial 48 hours of the outbreak. All the patients showed a sore throat, associated with myalgia and rachialgia (85%), headache (26%) and digestive signs (24%). They were given a systematic antibiotic therapy by a penicillin or a macrolide, so no post-streptococcal complication was observed. From 23 throat swabs, 10 Streptococcus pyogenes strains were recovered with identical chimiotype, antibiotype and serotype (T:11, M non typable). Five serological assays were performed on 33 paired (early and 15 days later) samples of serum: ASLO (latex agglutination and microtitration), ASH, ASD and ASK. ASLO microtitration with ASD appear to be the most profitable association. The cost of such an outbreak is very heavy. More, the operational capacity of this unit was seriously compromised as long as 6 days. Measures to be applied are those used for the prevention of foodborne diseases, including medical surveillance of the cooking staff and strict observance of cool conservation of cooked meals and foods.

Beuchat L.R. *Selective media for detecting and enumerating foodborne yeasts.* Int J Food Microbiol. 1993; 19(1) : 1-14.p Abstract: No one medium is satisfactory for detecting, isolating and enumerating all yeasts in all foods. Antibiotic-supplemented media such as dichloran rose Bengal chloramphenicol agar, tryptone glucose yeast extract chloramphenicol agar, oxytetracycline glucose yeast extract agar and rose Bengal chloramphenicol agar are superior to acidified potato dextrose agar and other acidified media for enumeration of the vast majority of spoilage yeasts. Dichloran glycerol (18%) agar performs well for enumerating moderately xerotolerant yeasts. Malt extract yeast extract glucose (up to 60%) can be used for detecting and enumerating moderate and extreme xerophiles. These media also support the growth of moulds. Lysine agar, Schwarz differential agar and Lin's wild yeast differential agar are used by the brewing industry to differentiate wild yeasts from brewer's strains. Lysine agar is selective for apiculate yeasts and ethanol sulfite yeast extract agar is selective for Saccharomyces. Both have application in wineries. Modified molybdate agar can be used to selectively isolate yeasts from tropical fruits. Preservative-resistant yeasts can be detected on malt acetic agar. The recommended incubation temperature is 25 degrees C, but incubation time between plating and counting colonies ranges from 5 days for determination of general populations of yeasts to 10 days for more for xerotolerant yeasts. There is need for new and improved media for selectively isolating various groups, genera, species and strains of yeasts capable of growing only under specific environmental conditions in specific types of foods and beverages.

Bhat R.V. et al. *A foodborne disease outbreak due to the consumption of moldy sorghum and maize containing fumonisin mycotoxins.* J Toxicol Clin Toxicol. 1997; 35(3) : 249-55.p Abstract: BACKGROUND: Unseasonal rains beginning in 1995 damaged the maize and sorghum crops harvested in a few villages of the Deccan plateau in India. Human consumption of those grains resulted in a foodborne disease outbreak characterized by abdominal pain, borborygmi and diarrhea. METHODS: A rapid epidemiological survey was conducted in the affected villages and a detailed house to house survey in selected villages. RESULTS: People in 27 out of 50 villages surveyed were affected and disease was seen only in households and subjects consuming the rain damaged moldy sorghum or maize. The disease was self limiting. Diarrhea was reproduced in day old cockerels fed contaminated grains from affected households. All 20 sorghum and 12 maize samples collected from affected households had Fusarium sp. as the dominant mycoflora and contained fumonisin B1 in the range of 0.14-7.8 mg/kg and 0.25-64.7 mg/kg, respectively. In contrast, samples collected from unaffected households had fumonisin B1 in low levels ranging from 0.07-0.36 mg/kg and 0.05-0.24 mg/kg, respectively. CONCLUSION: The higher water activity in the grains left in the field following harvest led to the production of high levels of fumonisin B1 and consumption of such grains by humans resulted in the disease.

Bhat R.V. et al. *Foodborne disease outbreak due to consumption of rancid biscuits.* J Toxicol Clin Toxicol. 1995; 33(3) : 219-22.p Abstract: A foodborne disease outbreak characterized by vomiting, abdominal pain and diarrhea, involving mostly children was investigated. Epidemiological, hospital and laboratory investigations indicated that the disease outbreak was associated with consumption of rancid biscuits abandoned in the street corner in a crowded locality of old city Hyderabad. The offensive flavors of rancidity were masked by the strong pineapple flavor used in the biscuits. Rancidity of the biscuits was confirmed by high peroxide value and acidity of extracted fat. Bacterial contamination was excluded by the total aerobic plate counts and negative tests for Staphylococcus and Salmonella.

Billy T.J. et al. *Hazard analysis and critical control point systems in the United States Department of Agriculture regulatory policy.* Rev Sci Tech. 1997; 16(2) : 342-8.p Abstract: Recent outbreaks of foodborne illness and studies by expert groups have established the need for fundamental change in the United States meat and poultry inspection programme to reduce the risk of foodborne illness. The Food Safety and Inspection Service (FSIS) of the United States Department of Agriculture (USDA) has embarked on a broad effort to bring about such change, with particular emphasis on the reduction of pathogenic micro-organisms in raw meat and poultry products. The publication on 25 July 1996 of the Final Rule on pathogen reduction and hazard analysis and critical control point (HACCP) systems was a major milestone in the FSIS strategy for change. The Final Rule provides a framework for change and clarifies the respective roles of industry and government in ensuring the safety of meat and poultry products. With the implementation of this Final Rule underway, the FSIS has been exploring ways in which slaughter inspection carried out under an HACCP-based system can be changed so that food safety risks are addressed more adequately and the allocation of inspection resources is improved further. In addition, the FSIS is broadening the focus of food safety activities to extend beyond slaughter and processing plants by working with industry, academia and other government agencies. Such co-operation should lead to the development of measures to improve food safety before animals reach the slaughter plant and after products leave the inspected establishment for distribution to the retail level. For the future, the FSIS believes that quantitative risk assessments will be at the core of food safety activities. Risk assessments provide the most effective means of identifying how specific pathogens and other hazards may be encountered throughout the farm-to-table chain and of measuring the potential impact of various interventions. In addition, these assessments will be used in the development and evaluation of HACCP systems. The FSIS is currently conducting a quantitative risk assessment for eggs, and several surveys and studies are being performed to supply data needed to conduct other risk assessments. The FSIS has established a food safety research agenda which will fill data gaps.

Birkhead G.S. et al. *Typhoid fever at a resort hotel in New York: a large outbreak with an unusual vehicle.* J Infect Dis. 1993; 167(5) : 1228-32.p Abstract: The largest outbreak of typhoid fever in the United States since 1981 occurred in 1989 among guests and staff at a New York hotel. There were 43 culture-confirmed and 24 probable cases among guests, 1 culture-confirmed case and 1 asymptomatic culture-positive case among hotel employees, and 1 culture-confirmed secondary case. Twenty-one persons were hospitalized and 2 had bowel perforation. Breakfast on 13 June was the only meal consumed by all ill persons (relative risk, infinite; P = .004). In a case-control study, case-patients were more likely than controls to have consumed orange juice (odds ratio, 5.6; 95% confidence interval, 1.1-54.7), which had been prepared in a 208-L container with ample opportunity for hand contact. No other food was associated with illness. S. typhi was isolated from the stool of an asymptomatic food worker who handled orange juice but who was not known to be a typhoid carrier. S. typhi is a foodborne pathogen with continuing potential to cause large outbreaks in the United States.

Bishai W.R. et al. *Food poisoning syndromes.* Gastroenterol Clin North Am. 1993; 22(3) : 579-608.p Abstract: Despite our society's advances in sanitation, food preservation, and hygiene, the prevalence of foodborne disease remains high (12.6 million cases per year in the United States). Although there is a constant need for education of food handlers and consumers, there is also a need for continued vigilant monitoring of coastal waters,

meat packing facilities, and imported foods. As long as antibiotics are used in poultry and cattle feeds, one can expect the incidence of antibiotic-resistant foodborne pathogens to rise. There are several promising areas of research in the field of foodborne illnesses. Molecular biologists are actively characterizing the genes that enable invasive enteric pathogens such as Salmonella and Yersinia to enter tissues, and the bacterial toxins associated with secretory diarrheas continue to be the subject of intense scrutiny. Epidemiologists are implementing new techniques such as DNA fingerprinting and multilocus enzyme electrophoresis for tracing pathogens in disease outbreaks. Similarly, the use of computers in the food industry facilitates the tracing of contaminated foods. Although the rates of foodborne illness may not decrease significantly during the next decade, we can expect more rapid identification and tracing of outbreaks as well as an improved understanding of the pathogenesis of the foodborne diseases.

Blackburn C.D. et al. *Development of antibiotic-resistant strains for the enumeration of foodborne pathogenic bacteria in stored foods.* Int J Food Microbiol. 1994; 24(1-2) : 125-36.p Abstract: Strains of Aeromonas spp., Salmonella enteritidis phage type 4, Salmonella typhimurium, verotoxigenic Escherichia coli 0157:H7 (VTEC) and Yersinia enterocolitica resistant to streptomycin, nalidixic acid and a combination of both antibiotics were selected. When compared with the parent strains, most of the antibiotic-resistant strains had slightly slower growth rates at their optimum incubation temperature but the difference was reduced progressively when the temperature was lowered. Some antibiotic-resistant strains had considerably slower growth rates in the presence of the relevant antibiotic and these were not used further. Several agar and impedance media with added streptomycin and nalidixic acid were assessed for the enumeration of the antibiotic-resistant strains in artificially contaminated stored foods. Differential/selective media were required to enumerate low numbers of antibiotic-resistant strains in certain foods. The following agar and impedance media were selected: Aeromonas Agar (Ryan) for Aeromonas spp., Xylose Lysine Agar and Lysine Iron Cysteine Neutral Red Medium for Salmonella, Eosin Methylene Blue Agar and Coliform Medium for VTEC, and Yersinia Selective Agar without selective agents for Yersinia enterocolitica. The agar and impedance media have been used successfully to enumerate antibiotic-resistant strains inoculated into foods and stored at different temperatures.

Blake P.A. *Epidemiology of cholera in the Americas.* Gastroenterol Clin North Am. 1993; 22(3) : 639-60.p Abstract: A persisting reservoir of the Gulf Coast strain of toxigenic V. cholerae O1 in Louisiana and Texas marshes and the shipment of seafood from these areas throughout the United States means that sporadic cases and outbreaks of cholera may occur anywhere in the country for the foreseeable future. Such cases are most likely to occur during warm months, especially between July and October. Physicians should think of cholera when consulted for severe watery diarrhea, even when the patient has no history of travel, and alert the laboratory. Experience has shown that US food and water sanitation is good enough to make either secondary transmission or large outbreaks unlikely; however, as long as we have foodborne and waterborne outbreaks of bacterial enteric diseases, the Gulf Coast strain may appear in a situation in which it can multiply and be ingested in large numbers by many people. The Latin American cholera epidemic has caused more cases of cholera in the United States in 2 years than the total of Gulf Coast strain cases identified during the past 20 years. The epidemic's future is uncertain. Despite knowing a great deal about cholera epidemiology, we cannot fully explain the ebb and flow of cholera epidemics. We do not know why cholera was apparently eliminated from the Western Hemisphere by 1900, nor can we predict which areas will be affected next or whether cholera will remain in a given area transiently or become endemic. The fact that cholera disappeared from the Western Hemisphere in the last century does not necessarily mean that it will disappear again. The situation is different now in several ways. The current pandemic is caused by the El Tor biotype, which persists better in the environment than does the classical biotype. Travel is now more frequent and more rapid. Finally, the population of the Western Hemisphere is about 14 times larger now than it was in 1850 and produces about 80,000 metric tons of human feces each day, of which only a fraction is treated. Thus, cholera will probably become endemic in Latin America and persist indefinitely.

Borch E. et al. *Hazard identification in swine slaughter with respect to foodborne bacteria.* Int J Food Microbiol. 1996; 30(1-2) : 9-25.p Abstract: Swine slaughter is an open process with many opportunities for the contamination of the pork carcass with potentially pathogenic bacteria; however, it does not contain any point where hazards are completely eliminated. Data on the prevalence of various pathogenic bacteria (Aeromonas hydrophila, Campylobacter coli/jejuni, Listeria monocytogenes, Salmonella spp., Staphylococcus aureus and Yersinia enterocolitica) in pigs, their growth and survival characteristics and ability to become established on the slaughter line are presented. The presentation covers the processing steps from lairage to chilling and is based on swine slaughter practices in Denmark, Norway and Sweden. The major contamination points during swine slaughter are pig-related, such as faecal and pharyngeal, and environmental. HACCP (Hazard Analysis Critical Control Point) and GMP (Good Manufacturing Practice) in swine slaughter must be focused on limiting this spread. The pathogenic bacteria show differences in their general mechanism of distribution. The major contamination source of Campylobacter spp., Salmonella spp. and Y. enterocolitica is the pig, and the contamination of carcasses with these bacteria may be limited, provided that only strict slaughtering procedures are used. Other organisms such as Aeromonas spp., L. moncytogenes/Listeria spp. and S. aureus can be endemic in the processing environment. Since endemic bacteria can be controlled by proper cleaning and disinfection, these organisms are useful as

indicators for the success of GMP rules. The following affiliation to CPs or CCPs made for specific steps during slaughter and dressing may serve as a guidance: (i) lairage (CP), (ii) killing (CP), (iii) scalding (CP), (iv) dehairing (CP), (v) singeing/flaming (CP), (vi) polishing (CP), (vii) circumanal incision and removal of the intestines (CCP), (viii) excision of the tongue, pharynx, and in particular the tonsils (CCP), (ix) splitting (CP), (x) post mortem inspection procedures (CCP) and (xi) deboning of the head (CCP).

Borgdorff M.W. et al. *Surveillance of foodborne diseases: what are the options?* World Health Stat Q. 1997; 50(1-2) : 12-23.p Abstract: Epidemiological data are needed for a variety of reasons, namely, informing public health authorities about the nature and magnitude of foodborne illnesses and their epidemiology, for the early detection of foodborne disease outbreaks, and for the planning, implementation and evaluation of food safety programmes. Thus, epidemiological surveillance of foodborne diseases is fundamental to any food safety programme. Various methods of foodborne surveillance may be utilized: (i) records for registration of deaths and hospital discharges; (ii) disease notification, (iii) sentinel surveillance, (iv) laboratory surveillance, (v) outbreak investigation and (vi) epidemiological research. This article reviews each method, its advantages and disadvantages, and its relevance for meeting the various objectives and needs.

Bower C.K. et al. *Resistance responses of microorganisms in food environments.* Int J Food Microbiol. 1999; 50(1-2) : 33-44.p Abstract: Food borne microorganisms display a broad spectrum of resistance responses to naturally occurring and intentionally added antimicrobial agents. Resistance may be conferred by innate structural features of the bacterial strain such as an impermeable outer membrane or a mechanism for antibiotic-inactivation. Bacteria previously susceptible to an antimicrobial compound can acquire resistance through mutation or through genetic transfer processes such as transformation, transduction, and conjugation. Resistance can also be conferred by biofilm formation on food processing surfaces as an adaptive response to protect colonies from cleaning and sanitation. Resistant pathogens are a global problem, facilitated by international trade of raw and processed foods. Cross resistance between clinical and nonclinical antimicrobials can exist and is of concern. The development of resistant foodborne pathogens has been attributed to increased antibiotic use in hospitals, outpatient facilities, and veterinary applications. Resistant microorganisms can also develop as a result of physical processes used in food preservation, such as acid treatments and irradiation processes. Strategies to effectively counter resistance development include: changing current practices of antibiotic usage, developing new antibiotics, applying hurdle preservation approaches, preventing bacterial adhesion, and utilizing competitive exclusion. This paper presents an overview of problems arising from the development of microbial resistance, and explores possible solutions for detecting and defeating the adaptive changes of microorganisms.

Boyce T.G. et al. *Recurrent outbreaks of Salmonella Enteritidis infections in a Texas restaurant: phage type 4 arrives in the United States.* Epidemiol Infect. 1996; 117(1) : 29-34.p Abstract: In recent years infection caused by Salmonella serotype Enteritidis (SE) phage type 4 has spread through Europe but has been uncommon in the USA. The first recognized outbreak of this strain in the USA occurred in a Chinese restaurant in EI Paso, Texas, in April 1993; no source was identified. In September 1993, a second outbreak caused by SE phage type 4 was associated with the same restaurant. To determine the cause of the second outbreak, we compared food exposures of the 19 patients with that of two control groups. Egg rolls were the only item significantly associated with illness in both analyses (first control group: odds ratio [OR] 8.2, 95% confidence interval [CI] 2.3-31.6; second control group: OR 13.1, 95% CI 2.1-97.0). Retrospective analysis of the April outbreak also implicated egg rolls (OR 32.4, 95% CI 9.1-126.6). Egg roll batter was made from pooled shell eggs and was left at room temperature throughout the day. These two outbreaks of SE phage type 4 likely could have been prevented by using pasteurized eggs and safe food preparation practices.

Boyce T.G. et al. *Vibrio cholerae O139 Bengal infections among tourists to Southeast Asia: an intercontinental foodborne outbreak.* J Infect Dis. 1995; 172(5) : 1401-4.p Abstract: To determine the source and extent of an outbreak of Vibrio cholerae O139 Bengal infections among 630 cruise ship passengers to Southeast Asia, a retrospective cohort study was done. Questionnaires were sent to all passengers from the United States, Canada, and the United Kingdom, and serum samples were requested from all passengers reporting diarrhea. A case was defined as diarrheal illness with onset between 8 and 28 February 1994 and a cholera antitoxic antibody titer > or = 800. Six passengers, including 1 with bacteremia, met the case definition. Illness was associated with eating yellow rice at a buffet restaurant in Bangkok on 10 February (relative risk undefined, P = .005). This international outbreak demonstrates foodborne transmission of Vibrio cholerae O139 Bengal, an emerging cause of epidemic cholera in Asia, to tourists from Western countries. Physicians should suspect infection with either V. cholerae O1 or O139 in any patient with severe watery diarrhea after travel to the developing world.

Branen J. et al. *Activity of hydrolysed lactoferrin against foodborne pathogenic bacteria in growth media: the effect of EDTA.* Lett Appl Microbiol . 2000; 30(3) : 233-7.p Abstract: Lactoferrin was hydrolysed with pepsin and the antimicrobial activity of the resulting hydrolysate (HLF) was studied in 1% peptone, 0.05% yeast extract, 1% glucose (PYG) medium and tryptic soy broth (TSB). HLF was effective against Listeria monocytogenes, enterohaemorrhagic Escherichia coli and Salmonella enteritidis in PYG, however, the highest studied

concentration (1.6 mg ml-1) did not inhibit growth of any of these organisms in TSB. The addition of EDTA enhanced the activity of HLF in TSB, indicating that the decreased activity of HLF may have been due, in part, to excess cations in the medium.

Brosch R. et al. *[10 years foodborne listeriosis--an evaluation].* Wien Klin Wochenschr. 1992; 104(6) : 149-57.p Abstract: Foodborne listeriosis outbreaks, which occurred in the past 10 years, have raised new questions in listeriosis epidemiology. The renewed interest in listeriosis and Listeria monocytogenes has resulted in various efforts, which enormously enriched the knowledge about his relatively rare, but because of the high mortality rate, important infectious disease as well as about its causative agent. New data concerning epidemiology and therapy of human listeriosis as well as new experience with Listeria monocytogenes regarding virulence, typing, isolation, identification, occurrence in food and environment, behaviour towards disinfectants etc. have changed the view of human listeriosis prevention. The new aspects are summarized in this review.

Bruhn C.M. *Consumer concerns: motivating to action.* Emerg Infect Dis. 1997; 3(4) : 511-5.p Abstract: Microbiologic safety is consumers' most frequently volunteered food safety concern. An increase in the level of concern in recent years suggests that consumers are more receptive to educational information. However, changing lifestyles have lessened the awareness of foodborne illness, especially among younger consumers. Failure to fully recognize the symptoms or sources of foodborne disease prevents consumers from taking corrective action. Consumer education messages should include the ubiquity of microorganisms, a comprehensive description of foodborne illnesses, and prevention strategies. Product labels should contain food-handling information and warnings for special populations, and foods processed by newer safety-enhancing technologies should be more widely available. Knowledge of the consequences of unsafe practices can enhance motivation and adherence to safety guidelines. When consumers mishandle food during preparation, the health community, food industry, regulators, and the media are ultimately responsible. Whether inappropriate temperature control, poor hygiene, or another factor, the error occurs because consumers have not been informed about how to handle food and protect themselves. The food safety message has not been delivered effectively.

Buchanan R. *Principles of risk assessment for illness caused by foodborne biological agents. National Advisory Committee on Microbiological Criteria for Foods.* J Food Prot. 1998; 61(8) : 1071-4.p Abstract: The Risk Assessment Subcommittee of the National Advisory Committee on Microbiological Criteria in Foods has prepared a generic document on the principles of risk assessment as applied to biological agents that can cause human foodborne disease. Typical biological agents include bacteria, viruses, fungi, helminths, protozoa, algae, parasites, and the toxic products that these agents may produce. Basic principles elaborated to characterize food pathogen risks include the four broadly accepted components of risk assessment. The role of surveillance and investigational activities to link biological agents and their food sources to consumer illness is described as is the role of predictive modeling for food pathogens.

Buchanan R.L. *Acquisition of microbiological data to enhance food safety.* J Food Prot. 2000; 63(6) : 832-8.p Abstract: The routine acquisition and archiving of microbiological data is undertaken for two reasons. The first is the development of historical microbiological profiles of foods, ingredients, or processes in order to determine or verify that microorganisms of concern are being controlled to the level desired. The second reason is data concerning the pathogenicity or virulence of foodborne pathogens and their behavior in foods in order to develop strategies and criteria for assuring microbiological safety. Both types of microbiological data are essential to effective food safety programs. A firm understanding of the uses and limitations of both is essential to correct acquisition, interpretation, and use of such data.

Buchanan R.L. *Identifying and controlling emerging foodborne pathogens: research needs.* Emerg Infect Dis. 1997; 3(4) : 517-21.p Abstract: Systems for managing the risks associated with foodborne pathogens are based on detailed knowledge of the microorganisms and the foods with which they are associated--known hazards. An emerging pathogen, however, is an unknown hazard; therefore, to control it, key data must be acquired to convert the pathogen from an unknown to a known hazard. The types of information required are similar despite the identity of the new agent. The key to rapid control is rapid mobilization of research capabilities targeted at addressing critical knowledge gaps. In addition, longer-term research is needed to improve our ability to respond quickly to new microbial threats and help us become more proactive at anticipating and preventing emergence. The type of contingency planning used by the military in anticipating new threats serves as a useful framework for planning for new emergence.

Buchanan R.L. et al. *Microbial risk assessment: dose-response relations and risk characterization.* Int J Food Microbiol. 2000; 58(3) : 159-72.p Abstract: Characterizations of the risks associated with foodborne pathogens are dependent on the availability of information on the population's exposure to the biological agents. However, by itself, exposure data are insufficient to assess the public health impact of pathogenic microorganisms. This requires the availability of effective dose-response models. Successful development of models that describe dose-response relations for enteric pathogens is dependent on a sound understanding of the mechanisms of pathogenicity associated with individual pathogens. This includes knowledge of how the various pathogen, host, and food matrix factors influence pathogenicity. Currently, a group

of sigmoidal mathematical equations are used to empirically describe dose-response relations. While these have proven to be highly useful, advances in microbial food safety risk assessment will likely require the development of mechanistic models that more effectively consider the range of factors that influence the frequency and severity of foodborne infections in a population.

Buchholz U. et al. *Haff disease: from the Baltic Sea to the U.S. shore.* Emerg Infect Dis. 2000; 6(2) : 192-5.p Abstract: Haff disease, identified in Europe in 1924, is unexplained rhabdomyolysis in a person who ate fish in the 24 hours before onset of illness. We describe a series of six U.S. patients from 1997 and report new epidemiologic and etiologic aspects. Although Haff disease is traditionally an epidemic foodborne illness, these six cases occurred in two clusters and as one sporadic case.

Buchrieser C. et al. *Pulsed-field gel electrophoresis applied for comparing Listeria monocytogenes strains involved in outbreaks.* Can J Microbiol. 1993; 39(4) : 395-401.p Abstract: Recent food-borne outbreaks of human listeriosis as well as numerous sporadic cases have been mainly caused by Listeria monocytogenes serovar 4b strains. Thus, it was of interest to find out whether a certain clone or a certain few clones were responsible for these cases and especially for outbreaks. We used pulsed-field gel electrophoresis of large chromosomal DNA restriction fragments generated by ApaI, SmaI, or NotI to analyse 75 L. monocytogenes strains isolated during six major and eight smaller recent listeriosis outbreaks. These strains could be divided into 20 different genomic varieties. Thirteen of 14 strains isolated during major epidemics in Switzerland (1983-1987), the United States (California, 1985) and Denmark (1985-1987) demonstrated indistinguishable DNA restriction patterns. In contrast, strains responsible for the outbreaks in Canada (Nova Scotia, 1981), the United States (Massachusetts, 1983), France (Anjou, 1975-1976), New Zealand (1969), and Austria (1986) and some smaller outbreaks in France (1987, 1988, 1989) were each characterized by particular combinations of DNA restriction patterns. Seventy-seven percent of the tested strains could be classified into the previously described ApaI group A (Brosch et al. 1991), demonstrating a very close genomic relatedness. Because 49% of the epidemic strains selected for this study belonged to phagovar 2389/2425/3274/2671/47/108/340 or 2389/47/108/340, fifty-six additional strains of these phagovars, isolated from various origins, were also typed to determine whether differences in DNA restriction profiles between epidemic and randomly selected strains of the same phagovars could be pointed out. Variations in DNA patterns appeared more frequently within randomly selected strains than within epidemic strains.

Buisson Y. *[Food poisoning outbreaks: an epidemiological study]*. Ann Gastroenterol Hepatol (Paris). 1992; 28(6-7) : 268-73.p Abstract: The occurrence of foodborne disease outbreaks (FDO) is increasing in industrialized countries. Most of these outbreaks (2/3) are notified from restaurants and other commercial establishments but more and more from households. Salmonella is the major agent of FDO, especially S. enteritidis for five years. However, its role may be overestimated because inadequate microbiological techniques routinely performed. Despite recent progress, several outbreaks still go unnoticed. Every outbreak should be early investigated, with methodical collection of clinical, bacteriological and food data, followed by statistical analysis. Once identified the responsible pathogen, the contaminated food, the source of contamination and the bacterial growth enhancing factors, rapid control measures can prevent further epidemics. Compulsory notification of all FDO to the public health services is the condition for the reliability of a national surveillance programme.

Bunning V.K. et al. *Chronic health effects of microbial foodborne disease.* World Health Stat Q. 1997; 50(1-2) : 51-6.p Abstract: The acute effects of foodborne disease are sometimes not the end of the illness. Several significant foodborne pathogens are capable of triggering chronic disease, and even permanent tissue or organ destruction, probably via immune mechanisms. Arthritis, septic and reactive, inflammatory bowel disease, haemolytic uraemic syndrome, Guillain-Barre syndrome, and possible several autoimmune disorders can be triggered by foodborne pathogens or their toxins. Research is needed to more fully understand the mechanisms by which the immune system is inappropriately activated by these common foodborne disease-causing agents.

Butzler J.P. et al. *Campylobacter: pathogenicity and significance in foods.* Int J Food Microbiol. 1991; 12(1) : 1-8.p Abstract: In the last 10 years Campylobacter jejuni has emerged as the most frequent cause of bacterial gastroenteritis in man. Acute enterocolitis, the most common presentation of C. jejuni infection, can affect persons of all ages. C. jejuni has been found in virtually every country where investigations have been carried out. The frequent finding of dysenteric stools suggests that mucosal damage due to an invasive process analogous to that seen in shigellosis is important in the pathogenesis. Campylobacteriosis in man is mainly a foodborne infection in which foods of animal origin, particularly poultry, play an important role. Epidemiological investigations have demonstrated a significant correlation between the handling and consumption of poultry meat and the occurrence of Campylobacter enteritis. Barbecues appear to present special hazards for infection, because they permit easy transfer of bacteria from raw meats to hands and other foods and from these to the mouth. Milk is sometimes found to be contaminated and consumption of raw milk has caused several outbreaks of campylobacteriosis. Campylobacter can remain viable in fresh cheese for only a short period of time. The organism is also found in shellfish, such as clams. Campylobacter is probably very vulnerable to factors such as high temperatures and dry environments, and also to the presence of oxygen in atmospheric concentrations. Therefore, it is assumed that the organism does not persist in products like pelleted feed,

meals, egg powder and spices, which are often contaminated by Salmonella. A number of preventive measures on different levels, taken simultaneously, are needed to reduce the incidence of campylobacteriosis in man.

Buzby J.C. et al. *Economic costs and trade impacts of microbial foodborne illness.* World Health Stat Q. 1997; 50(1-2) : 57-66.p Abstract: This article presents the economic costs of foodborne diseases for selected countries, the approaches used to calculate these costs, and a discussion on the interaction between microbial food safety issues and international trade in food. The human illness costs due to foodborne pathogens are estimated most completely in the United States of America, where, each year, 7 foodborne pathogens (Campylobacter jejuni, Clostridium perfringens, Escherichia coli 0157:H7. Listeria monocytogenes, Salmonella, Staphylococcus aureus, and Toxoplasma gondii) cause an estimated 3.3-12.3 million cases of foodborne illness and up to 3900 deaths. These 7 pathogens are found in animal products and cost the United States an estimated $6.5-$34.9 billion (1995 US$) annually. The presence of foodborne pathogens in a country's food supply not only affects the health of the local population, but also represents a potential for spread to pathogens to visitors to the country and to consumers in countries which import food products. With more complete data on foodborne illnesses, deaths, costs and international trade rejections in each country, indicators could be developed by which changes in food safety can be monitored.

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Cabelof D.C. *Preventing infection from foodborne pathogens in liver transplant patients.* J Am Diet Assoc. 1994; 94(10) : 1140-4.p Abstract: Patients who have had an orthotopic liver transplantation (OLT) experience impaired immune function resulting from the disease process and the therapeutic use of immunosuppressive and antibacterial drugs. Immunoimpairment increases the risk of foodborne illness from bacteria, viruses, fungi, and parasites. This article describes the organisms known to cause clinically important infections and their food sources, the distinctive clinical consequences of the infection in patients who have had an OLT, and methods of preventing foodborne illness in these patients and others. Dietitians are the health care providers typically responsible for teaching OLT patients and their caregivers about safe food handling and appropriate food choices.

Caceres V.M. et al. *A foodborne outbreak of cyclosporiasis caused by imported raspberries.* J Fam Pract. 1998; 47(3) : 231-4.p Abstract: BACKGROUND: Cyclospora cayetanensis is a recently recognized parasite that causes prolonged diarrheal illness. Its modes of transmission have not been fully determined, although some investigations before 1996 implicated water. Outbreaks of cyclosporiasis in the United States in 1996 and 1997 are evidence of the increasing incidence of this disease. This report describes an outbreak of cyclosporiasis in persons who attended a luncheon on May 23, 1996, near Charleston, South Carolina. METHODS: In this retrospective cohort study, we interviewed all 64 luncheon attendees and the chef regarding food and beverage exposures. A case of cyclosporiasis was defined as diarrhea (> or = 3 loose stools per day or > or = 2 loose stools per day if using antimotility drugs) after attending the luncheon. We identified sporadic cases of cyclosporiasis and traced the implicated food. RESULTS: Of 64 luncheon attendees, 38 (59%) met the case definition. Persons who ate raspberries (relative risk [RR] = 5.4; 95% confidence interval [CI], 2.2-13.2) or potato salad (RR = 1.8; 95% CI, 1.2-2.6) were at significantly increased risk for illness. The population attributable risk percentages were 73% for raspberries and 20% for potato salad. Cyclospora oocysts were found in stools from 11 (85%) of the 13 case patients submitting specimens for testing. Implicated raspberries originated in Guatemala. CONCLUSIONS: Our investigation is one of the first studies to implicate a specific food (raspberries) as a vehicle for transmission of Cyclospora. Because of the apparent increasing incidence of cyclosporiasis in the United States, family physicians should consider testing for Cyclospora in any patient with prolonged, unexplained diarrhea.

Caffer M.I. et al. *Salmonella enteritidis in Argentina.* Int J Food Microbiol. 1994; 21(1-2) : 15-9.p Abstract: A significant increase in the number of isolations of Salmonella enteritidis has been observed in Argentina since 1986. Outbreaks of foodborne diseases in humans were associated with the consumption of raw or undercooked hens' eggs. Between 1986 and the first 6 months of 1993 there were 150 outbreaks reported, affecting more than 6000 persons. A total of 71.3% of these outbreaks were confirmed by stool cultures, and 47.3% by bacteriological study of the food implicated in the outbreak. A permanent surveillance of salmonellosis is imperative, taking into account the persistence of Salmonella enteritidis isolations in sporadic cases and in new outbreaks.

Campbell M.E. et al. *Effectiveness of public health interventions in food safety: a systematic review.* Can J Public Health. 1998; 89(3) : 197-202.p Abstract: PURPOSE: To summarize evidence on the effectiveness of public health interventions regarding food safety at restaurants, institutions, homes and other community-based settings. METHOD: This systematic review of published and unpublished studies involved a comprehensive literature search, screening for relevance, quality assessment of relevant studies, data extraction and synthesis. RESULTS: The interventions identified in 15 studies included in this review were grouped into three categories: inspections, food handler training, and community-based education. The evidence suggests that: routine inspection (at least once per year) of food service premises is effective in reducing the risk of foodborne illness; food handler training can improve the knowledge and practices of food handlers; and selected community-based education programs can increase public knowledge

of food safety. DISCUSSION: There is some evidence for the effectiveness of multiple public health interventions on food safety. Future research needs include evaluation of HACCP and community-based education programs.

Cann K.J. et al. *Cyclospora infections in England and Wales: 1993 to 1998.* Commun Dis Public Health. 2000; 3(1) : 46-9.p Abstract: The coccidian protozoon Cyclospora cayetanensis is a treatable cause of prolonged, watery diarrhoea in humans. Microbiology laboratories in England and Wales often restrict testing to those who have recently travelled abroad. Only 44 to 66 laboratory reports of C. cayetanensis are made in England and Wales each year and a large proportion are found to have visited developing countries. Large foodborne outbreaks of infection have arisen in North America among people who have not travelled abroad but no such outbreaks have been identified in the United Kingdom. Public health laboratories in England and Wales were surveyed in 1998 to investigate their procedures for identifying C. cayetanensis. Sixty-eight per cent actively looked for the protozoon, but only half used a recommended method of direct microscopy of formol ether concentrates. National external quality assurance results for all participating UK laboratories were reviewed to assess laboratory proficiency in identification. C. cayetanensis was correctly identified in a wet preparation by 58% of laboratories, the lowest rate for specimens containing a single parasite species. Cyclosporiasis could be acquired in the UK from imported food, but current laboratory procedures might fail to identify it. Ascertainment must improve and awareness needs to be raised among food handlers, public and environmental health workers, laboratory staff, and general practitioners. We recommend that laboratories test all patients with watery diarrhoea for > 1 week for cyclospora, use formol ether concentration and microscopy with a calibrated eyepiece graticule, and confirm diagnoses with the help of a reference laboratory.

Cartwright R.Y. et al. *Foodborne diseases in travellers.* World Health Stat Q. 1997; 50(1-2) : 102-10.p Abstract: It is encouraging that the problem of food- and waterborne disease in travellers is being increasingly recognized, but it is disappointing that to a large extent there is little effective action being taken. It is essential that the problem be recognized across government departments and joint programmes developed, particularly between ministries of health and tourism. Foodborne disease will always be a risk to travellers but this risk can be reduced by relatively simple programmes. The initial stage is to recognize the problem not just as an inconvenience to travellers but as an important economic factor which, unless controlled, can have severe effects on local, national and international trade.

Cassin M.H. et al. *Quantitative risk assessment for Escherichia coli O157:H7 in ground beef hamburgers.* Int J Food Microbiol. 1998; 41(1) : 21-44.p Abstract: Quantitative Risk Assessment (QRA) is a methodology used to organize and analyze scientific information to estimate the probability and severity of an adverse event. Applied to microbial food safety, the methodology can also help to identify those stages in the manufacture, distribution, handling, and consumption of foods that contribute to an increased risk of foodborne illness, and help focus resources and efforts to most effectively reduce the risk of foodborne pathogens. The term Process Risk Model (PRM) is introduced in this paper to describe the integration and application of QRA methodology with scenario analysis and predictive microbiology to provide an objective assessment of the hygienic characteristics of a manufacturing process. The methodology was applied to model the human health risk associated with Escherichia coli O157:H7 in ground beef hamburgers. The PRM incorporated two mathematical submodels; the first was intended to described the behaviour of the pathogen from the production of the food through processing, handling, and consumption to predict human exposure. The exposure estimate was then used as input to a dose-response model to estimate the health risk associated with consuming food from the process. Monte Carlo simulation was used to assess the effect of the uncertainty and variability in the model parameters on the predicted human health risk. The model predicted a probability of Hemolytic Uremic Syndrome of 3.7 x 10(-6) and a probability of mortality of 1.9 x 10(-7) per meal for the very young. These estimates are likely high for all hamburger meals, but may be reasonable for the home-prepared hamburgers described by this model. The efficacy of three risk mitigation strategies were evaluated by modifying the values of the predictive factors and comparing the new predicted risk. The average probability of illness was predicted to be reduced by 80% under a hypothetical mitigation strategy directed at reducing microbial growth during retail storage through a reduction in storage temperature. This strategy was predicted to be more effective than a hypothetical intervention which estimated a plausible reduction in the concentration of E. coli O157:H7 in the feces of cattle shedding the pathogen and one aimed at convincing consumers to cook hamburgers more thoroughly. The conclusions of this approach are only accurate to the extent that the model accurately represents the process. Currently, uncertainty and ignorance about the hygienic effects of the individual operations during production, processing, and handling limit the applicability of a PRM to specify HACCP criteria in a quantitative manner. However, with continuous improvement through stimulated research, a PRM should encompass all available information about the process, food, and pathogen and should be the most appropriate decision-support tool since it represents current knowledge.

Cassin M.H. et al. *Simulation modeling for microbial risk assessment.* J Food Prot. 1998; 61(11) : 1560-6.p Abstract: Quantitative microbial risk assessment implies an estimation of the probability and impact of adverse health outcomes due to microbial hazards. In the case of food safety, the probability of human illness is a complex function of the variability of many parameters that influence the microbial environment, from the production

to the consumption of a food. The analytical integration required to estimate the probability of foodborne illness is intractable in all but the simplest of models. Monte Carlo simulation is an alternative to computing analytical solutions. In some cases, a risk assessment may be commissioned to serve a larger purpose than simply the estimation of risk. A Monte Carlo simulation can provide insights into complex processes that are invaluable, and otherwise unavailable, to those charged with the task of risk management. Using examples from a farm-to-fork model of the fate of Escherichia coli O157:H7 in ground beef hamburgers, this paper describes specifically how such goals as research prioritization, risk-based characterization of control points, and risk-based comparison of intervention strategies can be objectively achieved using Monte Carlo simulation.

Chalmers R.M. et al. *Foodborne outbreaks of cyclosporiasis have arisen in North America. Is the United Kingdom at risk?* Commun Dis Public Health. 2000; 3(1) : 50-5.p Abstract: Cyclospora cayetanensis is a parasitic protozoon that causes prolonged watery diarrhoea. It is endemic in some developing countries, and recent foreign travel is often used as a selection criterion for screening in the United Kingdom (UK). Epidemiological investigations of outbreaks of cyclosporiasis among people in the United States and Canada who had not travelled abroad showed the infection to be foodborne and often associated with foods eaten raw. These included raspberries imported from Guatemala, and pesto (made with basil) and lettuce from other sources. Such foods are also being imported in increasing amounts to the UK, but no outbreaks have been documented, perhaps because none has occurred or because of poor ascertainment. This paper reviews the outbreaks reported from North America, evaluates the risks to the UK population, and suggests how surveillance could be improved.

Charbonneau D.L. et al. *A method of assessing the efficacy of hand sanitizers: use of real soil encountered in the food service industry.* J Food Prot. 2000; 63(4) : 495-501.p Abstract: In many outbreaks of foodborne illness, the food worker has been implicated as the source of the infection. To decrease the likelihood of cross-contamination, food workers must clean and disinfect their hands frequently. To ensure their effectiveness, hand disinfectants should be tested using rigorous conditions that mimic normal use. Currently, several different methods are used to assess the efficacy of hand disinfectants. However, most of these methods were designed with the health care worker in mind and do not model the specific contamination situations encountered by the food worker. To fill this void, we developed a model that uses soil from fresh meat and a means of quantifying bacteria that is encountered and transferred during food preparation activities. Results of studies using various doses of para-chloro-meta-xylenol and triclosan confirm that the method is reproducible and predictable in measuring the efficacy of sanitizers. Consistent, dose-dependent results were obtained with relatively few subjects. Other studies showed that washing hands with a mild soap and water for 20 s was more effective than applying a 70% alcohol hand sanitizer.

Chen H. et al. *Modes of inhibition of foodborne non-Salmonella bacteria by selenite cystine selective broth.* Int J Food Microbiol. 1994; 22(2-3) : 217-22.p Abstract: Various cell densities of six common foodborne non-Salmonella bacteria were exposed to selenite cystine (SC) Salmonella selective medium. The insensitivity of Pseudomonas aeruginosa and Proteus vulgaris to SC was confirmed. Selenite cystine selective medium was effective against the sensitive bacteria up to certain cell densities, beyond which the bacteria survived. As judged from the minimum cell number required for survival in SC, Staphylococcus aureus was the most sensitive to SC, followed by Bacillus cereus, Escherichia coli and Citrobacter freundii. When sensitive bacteria were grown in SC, they enriched resistant variants which exhibited no or reduced sensitivity to SC. The change in density of sensitive cells after exposure to SC suggested that bacterial sensitivity to SC depended on the efficiency of killing and growth inhibition by SC as well as the fraction of resistant variants in the bacterial population. Since Salmonella samples generally contain unknown numbers and types of sensitive bacteria, it is difficult to predict the effectiveness of their selective inhibition by SC.

Chhabra A.T. et al. *A predictive model to determine the effects of pH, milkfat, and temperature on thermal inactivation of Listeria monocytogenes.* J Food Prot. 1999; 62(10) : 1143-9.p Abstract: Listeria monocytogenes is a foodborne pathogen of significance because of its comparatively high heat resistance, zero tolerance in ready-to-eat foods, and growth at refrigeration temperatures. A 3 x 3 x 3 factorial study was done to determine the effects of milkfat (0%, 2.5%, 5.0%), pH (5.0, 6.0, 7.0), and processing temperature (55 degrees C, 60 degrees C, 65 degrees C) on the thermal resistance of L. monocytogenes in a formulated and homogenized milk system. Data were fit to a modified Gompertz equation where parameter estimates characterized three regions of a survival curve: the shoulder, maximum slope, and tail. Statistical analysis was done for each of the 27 individual treatment sets to visualize individual effects on parameter estimates and to evaluate how well the Gompertz equation represented the data. A regression model for the Gompertz equation was generated to predict the logarithmic surviving fraction of L. monocytogenes based on all 27 treatments and their single and interactive effects. The shoulder region of the survival curve was affected by pH; however, the maximum slope was affected by temperature, milkfat, and the interaction of temperature x milkfat. Validation of the model suggests that the predictions are best suited for processing above 62 degrees C. Trends over time for a 4-log reduction in cells (4D values) were evaluated using results from the 27 individual treatment sets, the regression model for the Gompertz equation, and a linear equation. At lower temperatures, 4D values by the three methods varied by twofold. At higher temperatures, all methods gave similar 4D values, suggesting that death became more linear. Based on this study all three factors affect heat resistance

for specific regions of a survival curve, and a predictive model was developed that can be used as a preliminary estimate for L. monocytogenes inactivation.

Choi W.Y. et al. *Foodborne outbreaks of human toxoplasmosis.* J Infect Dis. 1997; 175(5) : 1280-2.p Abstract: Two outbreaks of acute toxoplasmosis involving 8 adult patients in Korea were linked to eating uncooked pork. In the first outbreak, 3 patients developed unilateral chorioretinitis within 3 months of eating a meal consisting of raw spleen and liver of a wild pig. In the second outbreak, 5 of 11 soldiers who ate a meal consisting of raw liver of a domestic pig developed lymphadenopathy. All 8 patients had high levels of IgG Toxoplasma gondii antibodies (> or = 1:1024) in the Sabin-Feldman dye test, modified agglutination test incorporating mercaptoethanol, and latex agglutination test. T. gondii IgM antibodies persisted in these patients for several months. Most patients had a favorable response to anti-T. gondii chemotherapy with pyrimethamine and sulfanomides.

Chomel B.B. et al. *Changing trends in the epidemiology of human brucellosis in California from 1973 to 1992: a shift toward foodborne transmission.* J Infect Dis. 1994; 170(5) : 1216-23.p Abstract: From 1973 through 1992, 426 cases of human brucellosis were reported in California, of which 98% were laboratory confirmed. Brucella melitensis was identified in 185 cases (78.7% of the bacteriologically typed cases). Hispanics accounted for 81% of the cases from 1983 to 1992 compared with 65% during the previous decade ($P < .01$). The population-adjusted average annual incidence was higher in Hispanics, especially in children and teenagers, compared with non-Hispanic whites and African Americans. Slaughterhouse cases decreased from 25% during 1973-1982 to < 3% during the following decade. Changes in case distribution were characterized by a decreasing incidence in the Central Valley and an increasing incidence in the San Francisco Bay area and the southern Coast Range. Hispanics were more likely to report being infected by consumption of milk and cheese in Mexico during 1983-1992 than during the previous 10 years (relative risk, 1.45). Between 1973 and 1992, human brucellosis in California evolved from an occupational to a foodborne illness.

Chung K.T. et al. *Tannins and human health: a review.* Crit Rev Food Sci Nutr. 1998; 38(6) : 421-64.p Abstract: Tannins (commonly referred to as tannic acid) are water-soluble polyphenols that are present in many plant foods. They have been reported to be responsible for decreases in feed intake, growth rate, feed efficiency, net metabolizable energy, and protein digestibility in experimental animals. Therefore, foods rich in tannins are considered to be of low nutritional value. However, recent findings indicate that the major effect of tannins was not due to their inhibition on food consumption or digestion but rather the decreased efficiency in converting the absorbed nutrients to new body substances. Incidences of certain cancers, such as esophageal cancer, have been reported to be related to consumption of tannins-rich foods such as betel nuts and herbal teas, suggesting that tannins might be carcinogenic. However, other reports indicated that the carcinogenic activity of tannins might be related to components associated with tannins rather than tannins themselves. Interestingly, many reports indicated negative association between tea consumption and incidences of cancers. Tea polyphenols and many tannin components were suggested to be anticarcinogenic. Many tannin molecules have also been shown to reduce the mutagenic activity of a number of mutagens. Many carcinogens and/or mutagens produce oxygen-free radicals for interaction with cellular macromolecules. The anticarcinogenic and antimutagenic potentials of tannins may be related to their antioxidative property, which is important in protecting cellular oxidative damage, including lipid peroxidation. The generation of superoxide radicals was reported to be inhibited by tannins and related compounds. The antimicrobial activities of tannins are well documented. The growth of many fungi, yeasts, bacteria, and viruses was inhibited by tannins. We have also found that tannic acid and propyl gallate, but not gallic acid, were inhibitory to foodborne bacteria, aquatic bacteria, and off-flavor-producing microorganisms. Their antimicrobial properties seemed to be associated with the hydrolysis of ester linkage between gallic acid and polyols hydrolyzed after ripening of many edible fruits. Tannins in these fruits thus serve as a natural defense mechanism against microbial infections. The antimicrobial property of tannic acid can also be used in food processing to increase the shelf-life of certain foods, such as catfish fillets. Tannins have also been reported to exert other physiological effects, such as to accelerate blood clotting, reduce blood pressure, decrease the serum lipid level, produce liver necrosis, and modulate immunoresponses. The dosage and kind of tannins are critical to these effects. The aim of this review is to summarize and analyze the vast and sometimes conflicting literature on tannins and to provide as accurately as possible the needed information for assessment of the overall effects of tannins on human health.

Cieslak P.R. et al. *Preventable disease in correctional facilities. Desmoteric foodborne outbreaks in the United States, 1974-1991.* Arch Intern Med. 1996; 156(16) : 1883-8.p Abstract: BACKGROUND: Various disease outbreaks have been reported among prisoners. Recent foodborne outbreaks in correctional facilities in Georgia and Delaware prompted us to review the epidemiological characteristics of such outbreaks reported in the United States. METHODS: Foodborne outbreaks reported to the Centers for Disease Control and Prevention as part of routine surveillance from 1974 to 1991 were examined to identify outbreaks in jails, prisons, correctional facilities, and juvenile detention centers. Outbreak sizes, temporal trends, food vehicles, pathogens, and hygienic transgressions were analyzed. RESULTS: Eighty-eight desmoteric foodborne outbreaks involving 14307 cases of illness were reported from 31 states and territories. The mean outbreak size was 163 cases, compared with a mean of 31 cases for the 9107 reported outbreaks not involving prisoners. No fatalities among prisoners were reported. No pathogen was identified

in 47 (53%) of the 88 outbreaks Salmonella species accounted for 15 (37%) of 41 outbreaks of known cause from 1974 to 1991, Clostridium perfringens for 14 (34%), and Staphylococcus aureus for 9 (22%). Fourteen of 15 Salmonella outbreaks occurred from 1984 to 1991. Food vehicles were reported for 63 (72%) of the outbreaks. Beef and poultry each were implicated in 9 (14%) of these, followed by fish or poultry salads and Mexican food, which accounted for 6 outbreaks (10%). Food-handling errors were reported for 69 (78%) of the 88 outbreaks. Improper food storage was reported in 62 (90%) of these. CONCLUSIONS: Foodborne outbreaks are reported regularly from correctional facilities in the United States. Outbreaks caused by Salmonella species, a special threat to prisoners with human immunodeficiency virus infection, seem to be increasing. Food production in correctional facilities should meet minimum safety standards, including sufficient refrigeration facilities, training of food handlers, and exemption of ill food handlers from work.

Claesson B.E. et al. *A foodborne outbreak of group A streptococcal disease at a birthday party.* Scand J Infect Dis. 1992; 24(5) : 577-86.p Abstract: A severe foodborne outbreak of group A streptococcal disease (T28) affected 122/169 people (72%) who attended a church party or ate leftovers from the party. The median incubation time was 42 h. Muscular pain or weakness and fatigue usually preceded pharyngeal symptoms. Complications included otitis media with perforation, peritonsillitis requiring tonsillectomy, arthritis and pericarditis. A 45-year-old man died 36 h after he developed an influenza-like illness, and at necropsy there were histological signs of early streptococcal septicaemia. The strain produced erythrogenic exotoxins B and C. Streptococci were probably transmitted by sliced eggs on sandwiches. Laboratory experiments showed that there was an increment in viable count of streptococci with 6 logs after incubation in egg yolk for 24 h at room temperature. The unusually warm climate and flaws in food handling routines contributed to this large foodborne epidemic.

Clarke I.N. et al. *Viral zoonoses and food of animal origin: caliciviruses and human disease.* Arch Virol Suppl. 1997; 13 : 141-52.p Abstract: Caliciviruses are important veterinary and human pathogens. The viruses gain their name from characteristic cup-shaped structures seen on the virion surface by negative stain electron microscopy. In humans caliciviruses are a major cause of diarrhoeal disease. There are two fundamentally different genome structures amongst human caliciviruses. The Norwalk-like or small round structured viruses (SRSVs) are viruses that have an amorphous structure when viewed by EM, they have a genome composed of 3 major open reading frames (ORFs). These viruses cause epidemic gastroenteritis amongst all age groups. In contrast, the 'classic' human caliciviruses (HuCVs) display the typical calicivirus surface structure and have their capsid ORF fused to and contiguous with the non structural proteins forming one giant polyprotein. HuCVs are predominantly associated with paediatric infections and are only a minor cause of disease in humans. Spread of disease for both SRSVs and HuCVs is usually by faecal oral transmission. SRSVs are a major cause of foodborne gastroenteritis especially linked to the consumption of sewage-contaminated shellfish. However, there is no evidence that these viruses replicate in shellfish or that they originate from an animal source.

Cliver D.O. *Virus transmission via food.* World Health Stat Q. 1997; 50(1-2) : 90-101.p Abstract: Viruses are transmitted to humans via foods as a result of direct or indirect contamination of the foods with human faeces. Viruses transmitted by a faecal-oral route are not strongly dependent on foods as vehicles of transmission, but viruses are important among agents of foodborne disease. Vehicles are most often molluscs from contaminated waters, but many other foods are contaminated directly by infected persons. The viruses most often foodborne are the hepatitis A virus and the Norwalk-like gastroenteritis viruses. Detection methods for these viruses in foods are very difficult and costly; the methods are not routine. Indicators that would rapidly and reliably suggest the presence of viral contamination of foods are still being sought. Contamination can be prevented by keeping faeces out of food or by treating vehicles such as water in order to inactivate virus that might be carried to food in this way. Virus cannot multiply in food, but can usually be inactivated by adequate heating. Other methods of inactivating viruses within a food are relatively unreliable, but viruses in water and on exposed surfaces can be inactivated with ultraviolet light or with strong oxidizing agents.

Cohen A.E. et al. *Evaluation of a rapid and automated enzyme-linked fluorescent immunoassay for detecting Escherichia coli serogroup O157 in cheese.* J AOAC Int. 1996; 79(4) : 858-60.p Abstract: The Vitek Immunodiagnostic Assay System (VI-DAS) for Escherichia coli O157, a rapid and fully automated test, was evaluated for use in detecting the foodborne pathogen E. coli O157:H7 in soft, semisoft, and hard cheeses. Sixty-five cheese samples were artificially contaminated at low (2-4 colonyforming units [cfu]/25 g) and high (7-10 cfu/25 g) levels with one of 2 strains of enterohemorrhagic E. coli O157:H7. Contamination at high levels was detected in all cheeses by VIDAS, whereas in 5 cheeses (7.7%) inoculated at low levels, contamination was not detected. In 15 additional cheeses inoculated with cold-stressed cells, both VIDAS and the Bacteriological Analytical Manual cultural assay detected all high and low levels of contamination. No false positives or interference from product background fluorescence was encountered in any of the cheeses tested by VIDAS.

Collins J.E. *Impact of changing consumer lifestyles on the emergence/reemergence of foodborne pathogens.* Emerg Infect Dis. 1997; 3(4) : 471-9.p Abstract: Foodborne illness of microbial origin is the most serious food safety problem in the United States. The Centers for Disease Control and Prevention reports that 79% of outbreaks between 1987 and 1992 were bacterial; improper holding

temperature and poor personal hygiene of food handlers contributed most to disease incidence. Some microbes have demonstrated resistance to standard methods of preparation and storage of foods. Nonetheless, food safety and public health officials attribute a rise in incidence of foodborne illness to changes in demographics and consumer lifestyles that affect the way food is prepared and stored. Food editors report that fewer than 50% of consumers are concerned about food safety. An American Meat Institute (1996) study details lifestyle changes affecting food behavior, including an increasing number of women in the workforce, limited commitment to food preparation, and a greater number of single heads of households. Consumers appear to be more interested in convenience and saving time than in proper food handling and preparation.

Cook K.A. et al. *Outbreak of Salmonella serotype Hartford infections associated with unpasteurized orange juice.* JAMA. 1998; 280(17) : 1504-9.p Abstract: CONTEXT: Acidic foods such as orange juice have been thought to be unlikely vehicles of foodborne illness. OBJECTIVE: To investigate an outbreak of Salmonella enterica serotype Hartford (Salmonella Hartford) infections among persons visiting a theme park in Orlando, Fla, in 1995. DESIGN: Review of surveillance data, matched case-control study, laboratory investigation, and environmental studies. SETTING: General community. PARTICIPANTS: The surveillance case definition was Salmonella Hartford or Salmonella serogroup C1 infection in a resident of or a visitor to Orlando in May or June 1995. In the case-control study, case patients were limited to theme park hotel visitors and controls were matched to case patients by age group and hotel check-in date. MAIN OUTCOME MEASURES: Risk factors for infection and source of implicated food. RESULTS: Sixty-two case patients from 21 states were identified. Both Salmonella Hartford and Salmonella enterica serotype Gaminara (Salmonella Gaminara) were isolated from stool samples of 1 ill person. Thirty-two case patients and 83 controls were enrolled in the case-control study. Ninety-seven percent of case patients had drunk orange juice in the theme park vs 54% of controls (matched odds ratio, undefined; 95% confidence interval, 5.2 to undefined). The orange juice was unpasteurized and locally produced. Salmonella Gaminara was isolated from 10 of 12 containers of orange juice produced during May and July, indicating ongoing contamination of juice probably because of inadequately sanitized processing equipment. CONCLUSIONS: Unpasteurized orange juice caused an outbreak of salmonellosis in a large Florida theme park. All orange juice was recalled and the processing plant closed. Pasteurization or other equally effective risk-management strategies should be used in the production of all juices.

Cornell J. et al. *Protracted outbreak of Salmonella typhimurium definitive phage type 170 food poisoning related to tripe, 'pig bag', and chitterlings.* Commun Dis Public Health. 1998; 1(1) : 28-30.p Abstract: An outbreak of food poisoning around South Yorkshire due to Salmonella typhimurium definitive phage type 170 related to eating tripe, 'pig bag', and chitterlings was associated with a common supplier. Possible links with other suppliers were considered. Twenty-two cases occurred between 11 April 1995 and 7 May 1995. The situation was complicated by the complex distribution network of suppliers and by possible cross contamination in the retail outlets. This complexity created difficulties in the collection, recording and subsequent analysis of the data. The investigation of the outbreak and the subsequent control measures are discussed. Some of the difficulties of monitoring foodborne intestinal disease are highlighted.

Cosentino S. et al. *In-vitro antimicrobial activity and chemical composition of Sardinian Thymus essential oils.* Lett Appl Microbiol. 1999; 29(2) : 130-5.p Abstract: Essential oils and their components are becoming increasingly popular as naturally occurring antimicrobial agents. In this work the chemical composition and the antimicrobial properties of Thymus essential oils and of their main components were determined. Three essential oils obtained from different species of Thymus growing wild in Sardinia and a commercial sample of Thymus capitatus oil were analysed. The essential oil components were identified by GC/MS analysis. The antimicrobial activity of the oils and components was determined against a panel of standard reference strains and multiple strains of food-derived spoilage and pathogenic bacteria, using a broth microdilution method. The GC/MS analysis showed that the major constituents of the oils were monoterpene hydrocarbons and phenolic monoterpenes, but the concentration of these compounds varied greatly among the oils examined. The results of the antimicrobial assay showed that essential oils extracted from Sardinian Thymus species have an antimicrobial activity comparable to the one observed in other thyme oils. It seems also confirmed that the antimicrobial properties of thyme essential oils are mainly related to their high phenolic content. Among the single compounds tested carvacrol and thymol turned out to be the most efficient against both reference strains and food-derived bacteria. The results of this study confirmed the possibility of using thyme essential oils or some of their components in food systems to prevent the growth of foodborne bacteria and extend the shelf-life of processed foods.

Cotterchio M. et al. *Effect of a manager training program on sanitary conditions in restaurants.* Public Health Rep. 1998; 113(4) : 353-8.p Abstract: OBJECTIVE: To evaluate the effectiveness of a food manager training and certification program in increasing compliance with restaurant sanitary codes. METHODS: Using routine sanitary inspection records, the authors compared pre- and post-training inspection scores for 94 restaurants falling into three groups: a "mandatory" group (managers' attendance was mandated for these restaurants); a "voluntary" group (managers attended the training voluntarily); and a control group (no staff attended the training program). RESULTS: Restaurants for which managers were mandated to attend a training and certification program demonstrated a significant

improvement in inspection scores, an improvement that was sustained over a two-year follow-up period. The mean inspection scores for a control group did not change significantly over time. However, improvements were not noted in all areas of food safety. CONCLUSIONS: Food manager training and certification programs may be an effective way to improve the sanitary conditions of restaurants and reduce the spread of foodborne illnesses.

Cowden J.M. et al. *Outbreaks of foodborne infectious intestinal disease in England and Wales: 1992 and 1993.* Commun Dis Rep CDR Rev. 1995; 5(8) : R109-17.p Abstract: We have analysed data from the surveillance scheme of general foodborne outbreaks of infectious intestinal disease in England and Wales reported to, or otherwise identified by, the PHLS Communicable Disease Surveillance Centre in 1992 and 1993. Data were available about 458 outbreaks, 197 (43%) in commercial catering premises (restaurants, cafes, hotels, public houses, and canteens), 77 (17%) associated with food prepared in private houses, and 58 (13%) in hospitals and residential institutions. Salmonellas and Clostridium perfringens were responsible for 340 outbreaks (74%) and no pathogen was identified in 55 outbreaks (12%). Organisms associated with the highest mean attack rates were Staphylococcus aureus (66%) and C. perfringens (53%). Eleven thousand people were reported to be il and 362 were admitted to hospital. There were 15 deaths, 13 of which were associated with salmonellosis. A specified food was suspected to be the vehicle of infection in 204 outbreaks (45%). Possible contributory factors were identified in 277 (61%), most commonly inappropriate storage, cross contamination, and inadequate heat treatment. Reducing the incidence of food poisoning will depend on concerted action on farms, in abattoirs and food processing plants, in wholesale and retail outlets, and in kitchens.

Craven S.E. et al. *Cecal carriage of Clostridium perfringens in broiler chickens given Mucosal Starter Culture.* Avian Dis. 1999; 43(3) : 484-90.p Abstract: Day-of-hatch broiler chicks housed in isolation units were each given, by oral gavage, 0.1 ml of Mucosal Starter Culture (MSC) or saline control. Each of the treated and control chicks was subsequently given a composite culture of three strains of bacitracin-resistant Clostridium perfringens (Cp) previously isolated from chickens with symptoms of necrotic enteritis. Some chicks were maintained on a corn-based diet provided ad libitum. Others were given the feed supplemented with 50% rye (a predisposing factor for necrotic enteritis). At 7, 14, and 21 days after receiving Cp, chicks were euthanatized, and cecal contents were diluted and plated on selective agar containing bacitracin. For chicks on corn feed, Cp numbers were similar in control birds and birds given MSC in three of four trials. In two of the trials that demonstrated no effect of MSC on Cp numbers, enterotoxin presence was determined. The number of birds with detectable Cp enterotoxin in their small intestine and the mean toxin levels were lower in the MSC-treated birds. In a fourth trial with birds on corn-based feed, mean Cp numbers and the number of Cp-positive birds were lower in the MSC-treated birds. For the two trials involving chickens on rye-supplemented feed, Cp numbers and the percentage of Cp-positive birds were significantly reduced in MSC-treated birds compared with control birds. Enterotoxin in birds receiving the 50% rye diet was at low levels or not detected in control and MSC-treated birds. Results suggest that MSC may reduce intestinal proliferation of Cp, a causative agent of necrotic enteritis in poultry and of foodborne disease in humans.

Crerar S.K. et al. *Foodborne disease: current trends and future surveillance needs in Australia.* Med J Aust. 1996; 165(11-12) : 672-5.p Abstract: Review of 128 outbreaks of foodborne disease (affecting almost 6000 people, with six deaths) between 1980 and 1995 and available surveillance data showed that foodborne disease in Australia is similar to that in other industrialised countries. Campylobacter spp. and non-typhoidal Salmonella spp. were the most commonly reported pathogens. However, Australia, unlike the UK and US, lacks a comprehensive national surveillance system for foodborne diseases. This is essential to improve control of these diseases.

Cullor J.S. *HACCP (Hazard Analysis Critical Control Points): is it coming to the dairy?* J Dairy Sci. 1997; 80(12) : 3449-52.p Abstract: The risks and consequences of foodborne and waterborne pathogens are coming to the forefront of public health concerns, and strong pressure is being applied on agriculture for immediate implementation of on-farm controls. The FDA is considering HACCP (Hazard Analysis Critical Control Points) as the new foundation for revision of the US Food Safety Assurance Program because HACCP is considered to be a science-based, systematic approach to the prevention of food safety problems. In addition, the implementation of HACCP principles permits more government oversight through requirements for standard operating procedures and additional systems for keeping records, places primary responsibility for ensuring food safety on the food manufacturer or distributor, and may assist US food companies in competing more effectively in the world market. With the HACCP-based program in place, a government investigator should be able to determine and evaluate both current and past conditions that are critical to ensuring the safety of the food produced by the facility. When this policy is brought to the production unit, the impact for producers and veterinarians will be substantial.

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D'Aoust J.Y. *Pathogenicity of foodborne Salmonella.* Int J Food Microbiol. 1991; 12(1) : 17-40.p Abstract: Salmonella remains a leading etiological agent in bacterial foodborne diseases. Although human salmonellosis generally presents as a self-limiting episode of enterocolitis, the disease can degenerate into chronic and debilitating conditions. Antibiotic treatment of uncomplicated salmonellosis is contra-indicated because it tends to prolong the carrier state. Clinical management of systemic infections with

newer drugs such as third-generation cephalosporins and quinolones is most promising, particularly in light of the increasing resistance of Salmonella to the traditional ampicillin, chloramphenicol and trimethoprim sulfamethoxazole therapeutic agents. Research into the development of effective vaccines from avirulent auxotrophic or from virulence plasmid-cured strains may ultimately facilitate the control of salmonellosis in human populations and in various agricultural sectors. Human salmonellosis reflects the outcome of a confrontation between humoral and cellular immune responses of the host, and virulence determinants of the invasive pathogen. Following an adhesion-dependent attachment of salmonellae to lumenal epithelial cells, the invasive pathogen is internalized within an epithelial cell by a receptor-mediated endocytotic process. Cytotoxin localized in the bacterial cell wall suggestively may facilitate Salmonella entry into the epithelial layer. Cytoplasmic translocation of the infected endosome to the basal epithelial membrane culminates in the release of salmonellae in the lamina propria. During this invasive process, Salmonella secretes a heat-labile enterotoxin that precipitates a net efflux of water and electrolytes into the intestinal lumen. Although non-typhoid salmonellae generally precipitate a localized inflammatory response in deeper tissues via lymphatics and capillaries, and elicit a major immune response. Current research efforts have focused on the molecular characterization and role of virulence plasmids and chromosomal genes in Salmonella pathogenicity.

D'Aoust J.Y. *Psychrotrophy and foodborne Salmonella.* Int J Food Microbiol. 1991; 13(3) : 207-15.p Abstract: Recent reports on the behaviour of Salmonella at chill temperatures (less than 10 degrees C) raise concerns on the purported safety of refrigerated foods. The propensity for growth of salmonellae within 10-28 days in complex broth (5.9 degrees C) and agar (4.0 degrees C) media is overshadowed by more recent evidence on their capability to proliferate in fresh meats (2.0 degrees C) and shell eggs (4.0 degrees C) within 6 and 10 days, respectively. Such findings, together with the inability of many domestic refrigerators to maintain uniformly cold temperatures, are disquieting. Gaseous mixtures of CO2, N2 and O2 are widely used to extend the shelf life of chilled foods, notably fresh meats. The high levels of CO2 used in modified atmosphere packaging or generated by endogenous microflora in vacuum-packaged foods effectively inhibit the growth of psychrotrophic spoilage bacteria. Current evidence suggests that this industrial practice also arrests the growth of Salmonella but exerts little or no effect on their survival. Enhancement of the bacteriostatic potentials of pH and NaCl as temperature deviates from the optimum for growth to lower values could further contribute to the safety of chilled foods.

D'Aoust J.Y. *Salmonella and the international food trade.* Int J Food Microbiol. 1994; 24(1-2) : 11-31.p Abstract: Non-typhoid Salmonella spp. continue to figure prominently in many national epidemiological registries as the leading cause of bacterial foodborne disease. Although Salmonella enterocolitis is generally a self-limiting illness that may require fluid and electrolyte replacement, the disease can spread systemically and degenerate into a chronic condition such as reactive arthritis, osteomyelitis, cardiac inflammation or neural disorders. Ampicillin, chloramphenicol and trimethoprim-sulfamethoxazole have provided the mainstay of therapy for the clinical management of bacteremic salmonellosis. However, the increasing occurrence of strains that are resistant to one or more of these traditional antibacterial drugs has resulted in the wider use of quinolones for the treatment of Salmonella septicaemia. Successful clinical results with these newer drugs are already being overshadowed by the emergence of salmonellae that are resistant to these therapeutic agents. A rapidly growing international trade in agricultural, aquacultural and manufactured food products has greatly facilitated the introduction of new Salmonella serovars within the geographical boundaries of importing countries. This paper reviews the prevalence of Salmonella in selected food types that are subject to the import-export market and attendant epidemiological overtones. More specifically, the importance of fresh fruits and vegetables, spices, cheese, and aquacultural products as vehicles of human infection will be underlined. The potential impact of the widespread use of antibiotics of importance in human medicine in the aquaculture industry will also be discussed. The ubiquitous distribution of Salmonella in the natural environment and its prevalence in the global food chain, the physiological adaptability and virulence of this important human bacterial pathogen, and its potentially serious economic impact on the food industry predicate the need for continued vigilance and stringent controls at all levels of food production.

D'Aoust J.Y. et al. *Efficacy of prolonged (48 h) selective enrichment for the detection of foodborne Salmonella.* Int J Food Microbiol. 1992; 15(1-2) : 121-30.p Abstract: The effect of prolonged (48 h) incubation on the productivity of five enrichment-temperature conditions (tetrathionate brilliant green, 35 and 43 degrees C; Muller-Kauffman tetrathionate brilliant green, 43 degrees C; Rappaport-Vassiliadis, 43 degrees C; selenite cystine, 35 degrees C) was compared to homologous results obtained under standard (24 h) conditions of selective enrichment. Of 797 high moisture and 166 low moisture foods tested, 171 (21.5%) and 80 (48.2%), respectively, were found to contain salmonellae by one or more analytical condition. Combined results of the five enrichment conditions after 24 and 48 h of incubation identified 247 (98.4%) and 250 (99.6%) of the 251 contaminated samples identified in this study. Our results are at variance with earlier reports on the greater method sensitivity with extended (greater than or equal to 48 h) periods of selective enrichment. The productivities of individual enrichment conditions after each period of incubation varied markedly where recovery rates with TBG43 and MKTBG43 exceeded that obtained with SC35 and TBG35. Our findings also underline the determinant role of enrichment at an elevated temperature (43 degrees C), and use of multiple enrichment and plating media for the optimal recovery of foodborne Salmonella.

D'Aoust J.Y. et al. *Recovery of Salmonella spp. from refrigerated preenrichment cultures of dry food composites.* J AOAC Int. 1995; 78(5) : 1322-7.p Abstract: Refrigerated preenrichment 72 h and selective enrichment cultures arising from 25 g analytical units of dry foods can be used to increase the analytical flexibility and productivity of laboratories for the detection of foodborne Salmonella spp. by AOAC method 994.04. Results of this intralaboratory study using artificially contaminated dry foods validate the extended application of the refrigerated preenrichment approach to dry food composites (375 g). All samples found to be contaminated by AOAC/Bacteriological Analytical Manual methods were identified readily from the homologous, refrigerated preenrichment broth cultures. This extended application of the refrigeration approach was recently adopted First Action by AOAC and was included as a modification to method 994.04. In addition, ancillary work on the diagnostic value of prolonged (48 h) incubation of lysine iron (LI) agar as described in the AOAC Official Method 967.26 led to a recommendation that the 48 h period of incubation be revoked in favor of a 24 h incubation of inoculated LI medium.

D'Aoust J.Y. et al. *A comparison of standard cultural methods for the detection of foodborne Salmonella.* Int J Food Microbiol. 1992; 16(1) : 41-50.p Abstract: The sensitivity of the standard cultural method of the International Organization for Standardization (ISO 6579 and ISO 3565 combined) was compared to that of the Health Protection Branch (HPB) procedure for the detection of foodborne Salmonella. Of 195 foods tested, 84 (43.1%) were found to contain salmonellae by one or more cultural conditions. Of these, 75 (89.3%) and 68 (81.0%) were identified by the ISO and HPB methods, respectively. The apparent lack of agreement between both methods likely stemmed from the low indigenous numbers of salmonellae in several food homogenates, and unequal transfer of the target microorganism into homologous ISO and HPB pre-enrichment broths. The sensitivities of the commercially available Muller-Kauffmann tetrathionate broth (MKTBG43, Oxoid CM343), and a closely-related medium prepared with Oxoid CM29 tetrathionate base varied from 86.9 to 89.3%, and were deemed equivalent to that obtained with the ISO formulation of MKTBG43 (89.3%). Comparatively fewer contaminated samples were identified from selenite cystine (SC35) and selenite brilliant green (SBG35) enrichment cultures (82.1-83.3%). The high selectivity and saccharide-independent response of the bismuth sulfite agar medium warrants its consideration as a mandatory plating medium in ISO methodologies for the effective detection of typical and atypical biotypes of foodborne Salmonella spp.

da Silva M.C. et al. *Incidence of Listeria monocytogenes in cheese produced in Rio de Janeiro, Brazil.* J Food Prot. 1998; 61(3) : 354-6.p Abstract: The present study evaluated the incidence of Listeria spp. in some Brazilian cheeses obtained from retail stores in Rio de Janeiro, Of 103 samples of various types of cheese examined as recommended in the Listeria isolation protocol of the Health Protection Branch of Canada, 11 (10.68%) were contaminated by Listeria monocytogenes, 13 (12.62%) by Listeria innocua, 6 (5.83%) by Listeria grayi, and 1 (0.97%) by Listeria welshimeri. A higher incidence of L. monocytogenes as observed mainly in the homemade Minas Frescal cheeses (a Brazilian soft white cheese, eaten fresh), 7 of 17 (41.17%), followed by ripened cheeses, 3 of 53 (5.67%), and industrially manufactured Frescal (Minas and Ricotta) cheeses, 1 of 33 (3.03%). Three serotypes (1/2a, 1/2b and 4b) were observed among the strains of L. monocytogenes isolated, all of them being frequently involved in outbreaks of foodborne listeriosis and sporadic cases of the disease all over the world.

Dadie A. et al. *[Isolation of enteric pathogeic agents in Cote d'Ivoire: Escherichia coli 0157:H7 and enteroaggregative E. coli]*. Bull Soc Pathol Exot. 2000; 93(2) : 95-6.p Abstract: New pathogens including Escherichia coli O157:H7 have emerged and spread world-wide as the most important cause of foodborne infections. We established a prospective study in Abidjan from 1996 to 1999 to determine the prevalence of Shiga-toxin producing E. coli (STEC) in our environment. Two O157 strains were found. One (EA47) O157:H7 was isolated from chicken and the other (EH144) O157:HNM from human diarrhoeal stool specimens. Both O157 strains carried stx2, eae, and UidA genes, but not e-hly one. Four other pathogenic E. coli were isolated, including three enteroaggregative E. coli (EAggEC) and one isolate which expresses a cytolethal distending toxin gene (cdtB). This is the first report of Shiga-toxin producing E. coli (STEC) in Cote d'Ivoire. Given its low prevalence (0.8%), E. Coli does not appear to be a public health problem in Cote d'Ivoire.

Dalton C.B. et al. *An outbreak of gastroenteritis and fever due to Listeria monocytogenes in milk.* N Engl J Med. 1997; 336(2) : 100-5.p Abstract: BACKGROUND: After an outbreak of gastroenteritis and fever among persons who attended a picnic in Illinois, chocolate milk served at the picnic was found to be contaminated with Listeria monocytogenes. METHODS: In investigating this outbreak, we interviewed the people who attended the picnic about what they ate and their symptoms. Surveillance for invasive listeriosis was initiated in the states that receive milk from the implicated dairy. Stool and milk samples were cultured for L. monocytogenes. Serum samples were tested for IgG antibody to listeriolysin O. RESULTS: Forty-five persons had symptoms that met the case definition for illness due to L. monocytogenes, and cultures of stool from 11 persons yielded the organism. Illness in the week after the picnic was associated with the consumption of chocolate milk. The most common symptoms were diarrhea (present in 79 percent of the cases) and fever (72 percent). Four persons were hospitalized. The median incubation period for infection was 20 hours (range, 9 to 32), and persons who became ill had elevated levels of antibody to listeriolysin O. Isolates from stool specimens from patients who became ill after the picnic, from sterile sites in three additional patients

identified by surveillance, from the implicated chocolate milk, and from a tank drain at the dairy were all serotype 1/2b and were indistinguishable on multilocus enzyme electrophoresis, ribotyping, and DNA macrorestriction analysis. CONCLUSIONS: L. monocytogenes is a cause of gastroenteritis with fever, and sporadic cases of invasive listeriosis may be due to unrecognized outbreaks caused by contaminated food.

Daniels N.A. et al. *A foodborne outbreak of gastroenteritis associated with Norwalk-like viruses: first molecular traceback to deli sandwiches contaminated during preparation.* J Infect Dis. 2000; 181(4) : 1467-70.p Abstract: In March 1998, an outbreak of acute gastroenteritis occurred among students at a Texas university. Overall, 125 ill students sought medical care. Case-control studies revealed that illness was significantly associated with eating foods from the university's main cafeteria deli bar on 9 and 10 March. Stool specimens from 9 (50%) of 18 ill students and samples of deli ham showed evidence of Norwalk-like viruses (NLVs) by reverse-transcriptase (RT) polymerase chain reaction (PCR) assay. A food handler who prepared sandwiches for lunch on 9 March reported that her infant had been sick with watery diarrhea since just before the outbreak. A stool sample from the infant was positive for NLV by RT-PCR, and the sequence of the amplified product was identical to that of amplified product from deli ham and students' stool specimens. This is the first time RT-PCR and sequence analysis have successfully confirmed viral contamination of a food item likely to have been contaminated by a food handler.

Daniels N.A. et al. *Vibrio parahaemolyticus infections in the United States, 1973-1998.* J Infect Dis. 2000; 181(5) : 1661-6.p Abstract: Vibrio parahaemolyticus infections are associated with consumption of raw or undercooked shellfish, contaminated food, and exposure of wounds to warm seawater. Foodborne outbreaks and sporadic infections from Vibrio species in 4 Gulf Coast states are reported routinely to the Centers for Disease Control and Prevention (CDC). Between 1988 and 1997, 345 sporadic V. parahaemolyticus infections were reported: 59% were gastroenteritis, 34% were wound infections, 5% were septicemia, and 2% were from other exposures. Forty-five percent of patients suffering from these conditions were hospitalized for their infections, and 88% of persons with acute gastroenteritis reported having eaten raw oysters during the week before their illness occurred. Between 1973 and 1998, 40 outbreaks of V. parahaemolyticus infections were reported to the CDC, and these outbreaks included >1000 illnesses. Most of these outbreaks occurred during the warmer months and were attributed to seafood, particularly shellfish. The median attack rate among persons who consumed the implicated seafood was 56%. To prevent V. parahaemolyticus infections, persons should avoid consumption of raw or undercooked shellfish and exposure of wounds to seawater.

Daniels N.A. et al. *Traveler's diarrhea at sea: three outbreaks of waterborne enterotoxigenic Escherichia coli on cruise ships.* J Infect Dis. 2000; 181(4) : 1491-5.p Abstract: Enterotoxigenic Escherichia coli (ETEC) has become the leading bacterial cause of gastroenteritis outbreaks on cruise ships. Investigation of recent outbreaks of ETEC gastroenteritis on 3 cruise ships indicated that all were associated with consuming beverages with ice cubes on board the ship (relative risk [RR], 1.4, 95% confidence interval [CI], 1.0-1.9, P=.02; RR, 1.9, 95% CI, 1.3-2. 9, P<.001; and RR, 1.3, 95% CI, 1.0-1.6, P<.01), and 2 were associated with drinking unbottled water (RR, 2.7, 95% CI, 1.8-4.1, P<.001; RR, 1.7, 95% CI, 1.3-2.3, P<.001). Multiple ETEC serotypes were detected in patients' stool specimens in each of the 3 outbreaks, and 12 (38%) of 32 isolates were resistant to > or =3 antimicrobial agents. ETEC appears to be emerging as a waterborne pathogen on cruise ships. Water bunkered in overseas ports was the likely source of ETEC infection in these outbreaks. To ensure passenger safety, cruise ships that take on water in foreign ports must ensure that water treatment and monitoring systems function properly.

Davies P.R. et al. *Isolation of Salmonella serotypes from feces of pigs raised in a multiple-site production system.* J Am Vet Med Assoc. 1998; 212(12) : 1925-9.p Abstract: OBJECTIVE: To determine the prevalence and serotypes of Salmonella organisms in feces of pigs raised in a modern, multiple-site production system. DESIGN: Cross-sectional study of prevalence. SAMPLE POPULATION: Swine housed on 7 farms (1 gilt development farm, 2 breeding farms, 1 nursery farm, and 3 finishing farms) that formed a multiplesite production system. PROCEDURE: Fecal samples were obtained from 792 pigs (96 to 202/farm) and submitted for bacteriolgic culture of Salmonella organisms. RESULTS: Salmonellae were isolated from pigs on all 7 farms and from 95 of 792 (12%) fecal samples. Prevalence ranged from 3.4% at the gilt development farm to 18 and 22% at the breeding farms. Serotypes identified were Salmonella derby, S typhimurium var. copenhagen, S heidelberg, S typhimurium, S mbandaka, S worthington, and S tennessee. No single serotype was not isolated from all the farms of the production system and the most prevalent serotypes at the 3 finishing farms (S typhimurium or S typhimurium var. copenhagen) were not isolated from the breeding or nursery farms. CLINICAL IMPLICATIONS: Upstream infection (pigs infected before arriving at finishing farms) appears to be an unimportant source of Salmonella infection of finished hogs in multiple-site systems. High prevalence of Salmonella shedding in breeding animals suggests that food products derived from culled breeding livestock may be an important source of foodborne disease.

de Boer E. et al. *Methodology for detection and typing of foodborne microorganisms.* Int J Food Microbiol. 1999; 50(1-2) : 119-30.p Abstract: Over the past decade many improvements have been seen in both conventional and modern methods for the detection of pathogenic bacteria in foods. Modifications and automation of conventional

methods in food microbiology include sample preparation, plating techniques, counting and identification test kits. ATP bioluminescence techniques are increasingly used for measuring the efficiency of cleaning surfaces and utensils. Cell counting methods, including flow cytometry and the direct epifluorescent filter technique are suitable techniques for rapid detection of microorganisms, especially in fluids. Automated systems based on impedimetry are able to screen high numbers of samples based on total bacterial counts within 1 day. Immunoassays in a wide range of formats make rapid detection of many pathogens possible. Recently, there have been important developments in the use of nucleic acid-based assays for the detection and subtyping of foodborne pathogens. The sensitivity of these methods has been significantly increased by the use of the polymerase chain reaction and other amplification techniques. Alternative and rapid methods must meet several requirements concerning accuracy, validation, speed, automation, sample matrix, etc. Both conventional and rapid methods are used within hazard analysis critical control point programs. Further improvements especially in immunoassays and genetic methods can be expected, including the use of biosensors and DNA chip technology.

Deak T. *Simplified techniques for identifying foodborne yeasts.* Int J Food Microbiol. 1993; 19(1) : 15-26.p Abstract: Four problematic areas associated with the identification of foodborne yeasts are discussed. These consist of (1) the inability of conventional identification tests to recognize some common and important foodborne yeasts characterized by genomic differences (e.g., Saccharomyces cerevisiae, S. bayanus and S. pastorianus); (2) the delay in application of non-traditional identification methods such as DNA fingerprinting, chromosome karyotyping, protein electrophoretic patterns and fatty acid profiles for routine identification purposes; (3) the lack of commercially available manual or automated identification systems dedicated to the diagnosis of foodborne yeasts; and (4) the disregard for considering ecological frequency of yeasts in computerized probabilistic identification systems.

Deak T. et al. *Evaluation of the MicroScan enzyme-based system for the identification of foodborne yeasts.* J Appl Bacteriol. 1995; 79(4) : 439-46.p Abstract: Eighty-nine strains representing 36 species of foodborne yeasts isolated from fruit juice concentrates were identified using the Baxter MicroScan enzyme-based kit, conventional tests according to a simplified identification method (SIM), and the API 20C kit. Of the 15 test species included in the MicroScan database, only 40% were correctly identified; 13% gave scores of unacceptably low probabilities, 20% were misidentified, and 27% could not be identified. Of the 21 test species not in the MicroScan database, 38% were misidentified and 62% produced biocodes with between-species differences not larger than differences between strains within species. The reliability of the MicroScan enzyme-based system is questioned, in that different results were sometimes obtained upon retesting the same strains. The MicroScan enzyme-based system is rapid, providing results within 4 h. However, because of its restricted and specific database and unreliability, the system appears to be unsuited for the identification of foodborne yeasts.

Delcourt A. et al. *Microbial and mycotoxic contamination of peppers and food safety.* Boll Chim Farm. 1994; 133(4) : 235-8.p Abstract: Twelve random samples of pepper powders were analyzed for contamination by microorganisms of public health significance (bacteria, moulds) and for aflatoxin B1 concentration. Black peppers were more heavily contaminated than white peppers but the most important bacteria causing foodborne diseases were not isolated; The mould flora was dominated by xerophilic species, particularly Aspergillus fumigatus, A. flavus, A. niger and A. ochraceus. These potentially pathogenic species can be dangerous for predisposed patients. The most striking result concerns aflatoxin B1 which was detected in every sample analyzed and could not always be correlated with the occurrence of a mycotoxinogenic strain of Aspergillus, suggesting the use of a sterilizing treatment previously. So, the detection of aflatoxin B1 must be a necessary criterion to be added to microbial criteria to appreciate the quality of peppers.

DeMaio J. et al. *A major outbreak of foodborne gastroenteritis among Air Force personnel during Operation Desert Storm.* Mil Med. 1993; 158(3) : 161-4.p Abstract: An outbreak of foodborne gastroenteritis affected 648 United States Air Force personnel stationed in Jeddah, Saudi Arabia during Operation Desert Storm. The implicated food source was a locally catered meal. Despite the presence of an aggressive Air Force public health program, foodborne illness had a major impact on manpower and medical resources during a critical phase of military operations. It is the recommendation of the authors that the Air Force not rely on local caterers during future deployments.

Deneen V.C. et al. *The impact of foodborne calicivirus disease: the Minnesota experience.* J Infect Dis. 2000; 181 Suppl 2 : S281-3.p Abstract: The first outbreaks of Norwalk virus gastroenteritis in Minnesota were confirmed in 1982. Since then, Norwalk-like caliciviruses have been recognized to be the most common cause of foodborne disease outbreaks, accounting for 41% of all confirmed foodborne outbreaks in Minnesota from 1981-1998. Although laboratory confirmation of caliciviruses in stool samples was not attempted in most of these outbreaks, all conformed to epidemiologic criteria for defining outbreaks of Norwalk virus. Since 1996, the availability of polymerase chain reaction testing at the Minnesota Department of Health has allowed for the confirmation of calicivirus infection among patients involved in epidemiologically defined outbreaks of viral gastroenteritis. Results have confirmed the usefulness of characterizing foodborne disease outbreaks by epidemiologic criteria and also confirmed the importance of human caliciviruses as the leading cause of foodborne disease outbreaks in Minnesota.

Desenclos J.C. *[Epidemiology of toxic and infectious risk related to shellfish consumption]*. Rev Epidemiol Sante Publique. 1996; 44(5) : 437-54.p Abstract: For feeding purposes shellfish filter large amounts of water but also concentrate infectious agents and toxins that are present in the marine environment either naturally or because of pollution. Thus, the consumption of raw or undercooked shellfish is a substantial source of foodborne poisoning, mostly epidemic and sometimes sporadic. Most of shellfish-borne infectious diseases are linked to fecal contamination of the marine environment; they include: thyphoid fever, salmonellosis, shigellosis, campylobacteriosis, cholera, Norwalk or Norwalk-like gastroenteritis and hepatitis A. In warm climates, shellfish contains naturally occurring halopilic Vibrios and may cause severe sporadic infections (septicemias) among very susceptible consumers (immunocompromised). Shellfish also causes outbreaks of paralytic shellfish poisoning (PSP) and diarrheic shellfish poisoning (DSP) when they are contaminated by toxins produced when Dinophisis, a marine plancton, proliferates. Chemical compounds (heavy metals and organic toxins) that are dumped in the environment (soil, air, and water) also reach shellfish harvesting waters where they are cocentrated. Although acute or chronic effects of the chemical contamination of shellfish have not been clearly documented, the cadmium pollution of some shellfish harvesting waters raises a serious problem. Since it is impossible to prevent completely the contamination of coastal waters by any of the agents cited above, the prevention of shellfish-borne diseases requires monitoring of the marine environment and shellfish flesh (coliform count, Dinophysis toxins, heavy metals...). This surveillance allows the classification of growing areas as suitable or not for harvesting and distribution of shellfish. However, this surveillance is not always sensitive enough. Indicators of fecal pollution are particularly not reliable for shellfish viral contamination. A better knowledge of marine biology, the limitation of coastal waters pollution, improved surveillance, the development of more sensitive indicators, the responsabilisation of the industry and the information of the public on the health hazards associated with shellfish consumption are the key issues for the improvement of shellfish-borne disease prevention.

Desmarchelier P.M. *Foodborne disease: emerging problems and solutions.* Med J Aust. 1996; 165(11-12) : 668-71.p Abstract: Foodborne disease is increasing in industrialised countries for complex reasons, including changes in the aetiological agents, the population at risk and food production and processing. It is unlikely ever to be eliminated, but the risk can be minimised. A preventive, rather than reactive, approach to ensuring food safety from "paddock to plate" is proposed for Australia, bringing it in line with many of its trading partners.

Desmarchelier P.M. et al. *Evaluation of the safety of domestic food preparation in Malaysia.* Bull World Health Organ. 1994; 72(6) : 877-84.p Abstract: Food-handling practices were studied in 119 and 158 households, respectively, in an urban and a rural community in Peninsular Malaysia. Hazard analyses, including microbiological analysis of foods, were carried out in two households in each community and in a house that prepared food for distribution in the urban area. Kitchen hygiene was generally acceptable, although rated "poor" in some instances in the rural area. Food prepared for lunch was usually sufficient for dinner also, the leftover items being stored at ambient temperature until required. In the house that prepared food for distribution, breakfast was prepared during the evening, stored at ambient temperature overnight, and reheated before sale the next morning. There was a local preference for cooking food at temperatures close to boiling point; this reduced the numbers of vegetative cells but not those of spores. In some stored foods the populations of Staphylococcus aureus, Bacillus cereus and mesophilic aerobic bacteria increased, the last-mentioned reaching spoilage levels. Reheating reduced the populations of proliferating bacteria in most foods to acceptable levels but would not have destroyed heat-resistant enterotoxins. Because of their importance in combating acute bacterial foodborne disease, the control of the temperature and time factors during the cooking and storage of food should receive special attention in education on health and food safety.

Dieckmann H. et al. *[Investigation of foodborne outbreak due to Salmonella infantis using epidemiological and microbiological methods (published erratum appears in Gesundheitswesen 1999 Jun;61(6):298)]*. Gesundheitswesen. 1999; 61(5) : 241-7.p Abstract: In foodborne outbreaks, direct microbiological diagnosis is often not possible due to lack of remaining food samples. Therefore, in this investigation of an outbreak of Salmonella infantis at a fair, we chose an epidemiological approach in addition to microbiological testing. In a case control study, fair participants with symptoms of acute gastroenteritis as well as participants showing no signs of disease were interviewed by telephone. Questions concerning what food had been eaten at the fair and the course of disease had priority. Data analysis showed a significantly elevated odds ratio of 144 ($p < 0.00001$) for the consumption of potato salad. Salmonella infantis was cultured in faeces of symptomatic individuals as well as from left-over potato salad in high concentration. In conclusion, our data show that the cause of a foodborne outbreak can be detected through the application of epidemiologic methods with a high degree of certainty. In order to eliminate memory bias, a structured interview should be carried out as soon as possible after the initial outbreak.

Dietz V. et al. *Active, multisite, laboratory-based surveillance for Cryptosporidium parvum.* Am J Trop Med Hyg. 2000; 62(3) : 368-72.p Abstract: Cryptosporidium parvum leaped to the attention of the United States following the 1993 outbreak in Milwaukee, Wisconsin, which sickened 400,000 people. Other outbreaks in the United States have been associated with drinking and recreational water, consumption of contaminated foods, contact with animals,

and childcare attendance. Despite its public health importance, the number of people who become infected each year is not known. In 1997, active surveillance for C. parvum was added to the Foodborne Diseases Active Surveillance Network (FoodNet), a collaborative effort among the Centers for Disease Control and Prevention, selected state health departments, the U.S. Departments of Agriculture and Food and Drug Administration. During the first 2 years of surveillance, 1,023 laboratory-confirmed cases of cryptosporidiosis were detected in FoodNet (Connecticut, Minnesota, Oregon, and selected counties in California, Georgia, Maryland, and New York). The annual rate per 100,000 persons was 2.3. Sixteen percent of case-patients were hospitalized. A seasonal increase in case detection was noted in late summer among persons less than 15 years of age. These data represent the first active multistate ascertainment of laboratory-confirmed cryptosporidiosis cases and provide useful information on the burden of disease in the United States.

Dimier-Poisson I.H. et al. *Mechanisms of the Eimeria tenella growth inhibitory activity induced by concanavalin A and reticuloendotheliosis virus supernatants with interferon gamma activity in chicken macrophages and fibroblasts.* Avian Dis. 1999; 43(1) : 65-74.p Abstract: Pretreatment of chicken bone marrow macrophages and embryo fibroblasts with supernatants containing chicken interferon gamma (IFN-gamma) for 24 hr prior to inoculation inhibited intracellular Eimeria tenella replication, measured by [3H] uracil incorporation. The supernatants (Sns) were obtained from culture of lymphoblastoid cells transformed by a reticuloendotheliosis virus (REV) and chicken splenocytes stimulated with concanavalin A (Con A). The mechanisms of the E. tenella growth inhibitory activity induced by Sn REV and Sn Con A in chicken macrophages and fibroblasts were studied. Addition of oxygen scavengers (superoxide dismutase, D-mannitol, DABCO, benzoic acid, L-histidine hydrochloride) was able to overcome the inhibition of E. tenella replication after pretreatment with Sn REV or Sn Con A in macrophage cultures but not in fibroblast cultures. Nitric oxide (NO) synthesis was induced in macrophage culture treated with Sn REV or Sn Con A but not in fibroblast culture. Addition of NG monomethyl-L-arginine, an NO synthase inhibitor together with the supernatants was also able to overcome inhibition of E. tenella replication in macrophage culture. On the other hand, addition of L-tryptophan to Sn REV- or Sn Con A-treated fibroblasts was able to reverse the inhibitory effect on E. tenella replication. In conclusion, production of inorganic NO or toxic oxygen intermediates may be involved in the E. tenella growth inhibitory activity of chicken macrophages pretreated with supernatants containing an IFN-gamma activity, and cellular tryptophan depletion may be involved for chicken fibroblasts, thus matching the mechanisms of the IFN-gamma-induced growth inhibitory activity for protozoans in mammals.

Djuretic T. et al. *General outbreaks of infectious intestinal disease in England and Wales 1992 to 1994.* Commun Dis Rep CDR Rev. 1996; 6(4) : R57-63.p Abstract: Data from the surveillance scheme of general outbreaks of infectious intestinal disease in England and Wales, reported to the PHLS Communicable Disease Surveillance Centre (CDSC), were used to review 1280 of the 1594 outbreaks identified between 1 January 1992 and 31 December 1994 for which a minimum data set was captured. The number of outbreaks reported in each regional health authority ranged from 31 in Mersey to 221 in Yorkshire. The commonest pathogens reported were salmonellas in 32% (412) of outbreaks, small round structured virus (SRSV) in 27% (342), Clostridium perfringens in 7% (90), and Shigella sonnei in 4% (46). The main mode of transmission was described as foodborne in 50% (642), over half of which were caused by salmonellas, and person to person in 39% (496), over half of which were caused by SRSV. Most outbreaks transmitted from person to person occurred in hospitals and in residential institutions for elderly people. Outbreaks lasted from one to 217 days (median five days) and their duration varied with the pathogen. The median attack rate was 37%. Illness was reported in 34,158 people, 751 of whom (2%) were admitted to hospital. There were 55 deaths, 28 of which were associated with salmonella and 12 with SRSV. Most of the outbreaks reported and the associated morbidity and mortality could have been prevented by following standard food hygiene practices, implementing infection control policies, and ensuring that food entering kitchens was of the highest microbiological quality possible.

Doan C.H. et al. *Microbiology of potatoes and potato products: a review.* J Food Prot. 2000; 63(5) : 668-83.p Abstract: Many types of spoilage and pathogenic microorganisms exist on fresh, minimally processed, and fully processed potato products. Potatoes are processed into many products including frozen, dried, ready-to-eat, and minimally processed. The microbiological quality of finished potato products is influenced by the natural microflora, processing, handling, and human contact. The natural microflora of potatoes are influenced by soil and airborne inocula, agricultural practices, harvesting methods, and storage conditions. The microflora of processed products are influenced by all of the factors and conditions affecting the natural microflora as well as the processes applied to the product. Increased consumer demand for new and existing potato products highlights the importance of ensuring their microbiological safety. This review considers the sources of microorganisms, microflora, foodborne disease pathogens, and outbreaks associated with, and selected microbiological research involving, potatoes and potato products.

Donnelly C.W. *Concerns of microbial pathogens in association with dairy foods.* J Dairy Sci. 1990; 73(6) : 1656-61.p Abstract: Recent outbreaks of foodborne disease linked to Salmonella, Listeria, and Yersinia have highlighted consumer awareness of microbiological problems in the food supply. Such outbreaks affirm the need for improved testing, environmental monitoring, and epidemiological surveillance. This paper reviews the entry of microbial pathogens into foods, with an emphasis on dairy products,

by examining the contribution of the processing environment to microbial contamination. Numerous surveys, including a recent audit of dairy processing plants in Vermont, have revealed common foci of environmental contamination by Listeria and Yersinia persistent within dairy processing environments. With respect to dairy products, the bacterial pathogens discussed in this manuscript share a common source, raw milk. Characteristics possessed by Salmonella, Listeria, and Yersinia are compared and contrasted. In the case of Listeria, this bacterium's role as a newly emerged foodborne pathogen is discussed. Finally, the economic consequences associated with foodborne disease are highlighted, and future prospects related to foodborne illness are presented.

Donovan T.J. et al. *Culture media for the isolation and enumeration of pathogenic Vibrio species in foods and environmental samples.* Int J Food Microbiol. 1995; 26(1) : 77-91.p Abstract: The genus Vibrio now includes a large number of species. Clear evidence is only available for the aetiological role of V. cholerae, V. vulnificus and V. parahaemolyticus in foodborne diseases. Until recently, V. cholerae serogroup 0:1 was accepted as the cause of epidemic cholera. However, the designation of outbreaks of diarrhoeal diseases caused by V. cholerae 0:139 as clinical cholera has lead to renewed interest in Non 0:1 serogroups of V. cholerae. A wide range of enrichment and selective media for the isolation of vibrios has been developed. These media are reviewed with respect to their ability to recover and differentiate the target vibrios. Alkaline peptone water (APW) remains the recommended enrichment medium for vibrios in parallel with either salt polymyxin broth (SPB) or glucose teepol (or sodium dodecylsulphate) salt broth (GTSB) when tests for V. parahaemolyticus are required. Thiosulphate citrate bile salt agar (TCBS) in parallel with polymyxin mannose tellurite (PMT) or sodium dodecylsulphate polymyxin sucrose agar (SPS) are the recommended selective plating media.

Dosso M. et al. *[The role of bacterial diarrhea in developing countries].* Bull Soc Pathol Exot. 1998; 91(5 Pt 1-2) : 402-5.p Abstract: Bacterial diarrheas in developing countries remain a major public health problem. Cholera is endemo-endemic since 1970. Clusters of Shigella infections are commonly observed during the rainy season. Other enteropathogen cause nosocomial infections and foodborne diseases. The HIV epidemic determined the emergence of a new trend of enteric diseases caused by opportunistic bacteria such as Salmonella Enteritidis, S. Typhimurium. The risk factors associated with these infections remains almost unknown. Treatment failure is related to an incre of high level resistance strains.

Doyle M.P. *Escherichia coli O157:H7 and its significance in foods.* Int J Food Microbiol. 1991; 12(4) : 289-301.p Abstract: Escherichia coli O157:H7 was conclusively identified as a pathogen in 1982 following its association with two food-related outbreaks of an unusual gastrointestinal illness. The organism is now recognized as an important cause of foodborne disease, with outbreaks reported in the U.S.A., Canada, and the United Kingdom. Illness is generally quite severe, and can include three different syndromes, i.e., hemorrhagic colitis, hemolytic uremic syndrome, and thrombotic thrombocytopenic purpura. Most outbreaks have been associated with eating undercooked ground beef or, less frequently, drinking raw milk. Surveys of retail raw meats and poultry revealed E. coli O157:H7 in 1.5 to 3.5% of ground beef, pork, poultry, and lamb. Dairy cattle, especially young animals, have been identified as a reservoir. The organism is typical of most E. coli, but does possess distinguishing characteristics. For example, E. coli O157:H7 does not ferment sorbitol within 24 h, does not possess beta-glucuronidase activity, and does not grow well or at all at 44-45.5 degrees C. The organism has no unusual heat resistance; heating ground beef sufficiently to kill typical strains of salmonellae will also kill E. coli O157:H7. The mechanism of pathogenicity has not been fully elucidated, but clinical isolates produce one or more verotoxins which are believed to be important virulence factors. Little is known about the significance of pre-formed verotoxins in foods. The use of proper hygienic practices in handling foods of animal origin and proper heating of such foods before consumption are important control measures for the prevention of E. coli O157:H7 infections.

Dufrenne J. et al. *Characteristics of some psychrotrophic Bacillus cereus isolates.* Int J Food Microbiol. 1995; 27(2-3) : 175-83.p Abstract: Twelve strains of Bacillus cereus isolated from different food products and foodborne disease outbreaks, and able to grow at temperatures < 7 degrees C, were characterised. Generation times at 7 degrees C varied from 9.4 h up to 75 h. Lag phase of the vegetative cells at 7 degrees C was strongly influenced by the previous temperature history of the cells. Preincubation at 37 degrees C increased the duration of the lag phase drastically. The heat resistance at 90 degrees C (D90 degrees C-values in min) for spores produced at 30 degrees C varied from 2.2 to 9.2 min for 11 strains. One strain, however, showed a D90 degrees C-value of > 100 min. Germination of spores in milk was delayed compared to those grown in brain heart infusion broth (BHI). All strains showed production of the diarrheal type enterotoxin in BHI. Addition of 50 IU of nisin to skim milk resulted in a decrease of numbers for 9 of the 12 strains tested. At a nisin concentration of 250 IU, a decrease in bacterial numbers was observed for all strains tested.

Dufrenne J. et al. *The effect of previous growth conditions on the lag phase time of some foodborne pathogenic micro-organisms.* Int J Food Microbiol. 1997; 34(1) : 89-94.p Abstract: In current models for predicting microbial growth, the lag phase duration is expressed as a function of the growth rate of the micro-organism. We observed that in addition to the growth rate (as influenced by incubation temperature and NaCl contents), the pre-incubation temperature influences the lag phase duration of foodborne pathogenic micro-organisms.

Duncan H.E. et al. *Host-microbe interaction in the gastrointestinal tract.* Crit Rev Microbiol. 1995; 21(2) : 85-100.p Abstract: In order for an infection to occur, the target organ must come in contact with sufficient microbes, the microbe must possess specific virulence factors, these virulence factors must be expressed, and the defenses of the organ system must be overcome. This dynamic process, which is ongoing in all living entities, can be described by the following relationship: [formula: see text] The establishment of infection first occurs in a particular organ. This phenomenon is known as tissue trophism and the association of microbes with organ systems governs the practice of clinical microbiology and infectious disease. With some microbes (e.g., Giardia, Cryptosporidium) the interaction with the particular organ is so specific that infections are almost always confined to one site; with others (e.g., Salmonella, enterovirus) the microbe has the potential to become systemic. When attempting to establish health risk assessment from microbes by contact with food and drinking water, one must therefore consider that the gastrointestinal tract is a complex organ system with a variety of specific host defense mechanisms. It is only when the microbe has particular virulence factors for sites in gastrointestinal tract, and the specific host defense mechanisms in the gastrointestinal tract are breached, that infection of this organ system occurs. Therefore, the general terms "immunosuppression" or "immunocompromise" are meaningless unless the specific immune defect is known. A description of the microbial virulence factors active against the gastrointestinal tract and the defense mechanisms of this organ system are reviewed to provide a biological basis health risk assessment and future food and drinking water regulations.

Durborow R.M. *Health and safety concerns in fisheries and aquaculture.* Occup Med. 1999; 14(2) : 373-406.p Abstract: Only 10% of all foodborne illnesses in the United States are attributed to seafood, making seafood a relatively safe food commodity. The implementation of Hazard Analysis and Critical Control Points guidelines should make seafood consumption even safer. Concerns include closed-loop, indoor, water-recirculating production systems; harmful algal blooms in marine environments, which can cause paralytic, neurologic, amnesic, and diarrhetic shellfish poisonings and ciguatera fish poisoning; bacteria (such as Mycobacterium marinum and Streptococcus iniae) and nematode, cestode, trematode, and protozoan parasites found in fish that cause human infections; and the shellfish origin of Norwalk virus infection. Avoidance, control, and treatment of this wide range of maladies contracted by humans from fish are covered in this review article. Prevention of accidents in fisheries and aquaculture is receiving more attention by groups such as the FDA, OSHA, and the Working Group for Quality Assurance in Aquaculture Production, which is part of the federal Joint Subcommittee on Aquaculture in Washington, D.C.

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Edgcomb M.R. et al. *Electron paramagnetic resonance studies of the membrane fluidity of the foodborne pathogenic psychrotroph Listeria monocytogenes.* Biochim Biophys Acta. 2000; 1463(1) : 31-42.p Abstract: Listeria monocytogenes is a foodborne psychrotrophic pathogen that grows at refrigeration temperatures. Previous studies of fatty acid profiles of wild-type and cold-sensitive, branched-chain fatty acid deficient mutants of L. monocytogenes suggest that the fatty acid 12-methyltetradecanoic (anteiso-C(15:0)) plays a critical role in low-temperature growth of L. monocytogenes, presumably by maintaining membrane fluidity. The fluidity of isolated cytoplasmic membranes of wild-type (SLCC53 and 10403S), and a cold-sensitive mutant (cld-1) of L. monocytogenes, grown with and without the supplementation of 2-methylbutyric acid, has been studied using a panel of hydrocarbon-based nitroxides (2N10, 3N10, 4N10, and 5N10) and spectral deconvolution and simulation methods to obtain directly the Lorentzian line widths and hence rotational correlation times (tau(c)) and motional anisotropies of the nitroxides in the fast motional region. tau(c) values over the temperature range of -7 degrees C to 50 degrees C were similar for the membranes of strains SLCC53 and 10403S grown at 10 degrees C and 30 degrees C, and for strain cld-1 grown with 2-methylbutyric acid supplementation (which restores branched-chain fatty acids) at 30 degrees C. However, strain cld-1 exhibited a threefold higher tau(c) when grown without 2-methylbutyric acid supplementation (deficient in branched-chain fatty acids) compared to strains SLCC53, 10403S, and supplemented cld-1. No evidence was seen for a clear lipid phase transition in any sample. We conclude that the fatty acid anteiso-C(15:0) imparts an essential fluidity to the L. monocytogenes membrane that permits growth at refrigeration temperatures.

Ehiri J.E. et al. *Food safety control: overcoming barriers to wider use of hazard analysis.* World Health Forum. 1996; 17(3) : 301-3.p Abstract: Although appropriate steps can be taken to prevent or reduce risks to health, foodborne diseases have continued to present a serious public health challenge. The traditional approaches of inspection and end-product testing appear to have proved inadequate in tackling the problem and there is an urgent need to apply more rational and effective strategies. One such strategy is the Hazard Analysis Critical Control Point (HACCP) system.

Ellis A. et al. *A community outbreak of Salmonella berta associated with a soft cheese product.* Epidemiol Infect. 1998; 120(1) : 29-35.p Abstract: In September 1994, a complaint was registered at a public health unit concerning a cheese product. In addition, public health laboratories in Ontario reported an increase in the number of isolates of Salmonella berta from patients with diarrhoeal illness. A clinical, environmental and laboratory investigation was initiated to determine the nature of this outbreak. Isolates of

Salmonella berta were compared using large fragment genomic fingerprinting by pulsed-field gel electrophoresis (PFGE). By late October, 82 clinical cases had been identified including 35 confirmed, 44 suspected and 3 secondary. The investigation linked illness to consumption of an unpasteurized soft cheese product produced on a farm and sold at farmers' markets. Subtyping results of patient, cheese and chicken isolates were indistinguishable, suggesting that the cheese was contaminated by chicken carcasses during production. The outbreak illustrates the potential role of uninspected home-based food producers and of cross-contamination in the transmission of foodborne bacterial pathogens.

Elsner H.A. et al. *Nosocomial infections by Listeria monocytogenes: analysis of a cluster of septicemias in immunocompromised patients.* Infection. 1997; 25(3) : 135-9.p Abstract: From December 1994 to November 1995 an unusual accumulation of Listeria infections occurred at the University Hospital Hamburg-Eppendorf, Germany. Eleven immunosuppressed patients from different departments developed septicemia due to Listeria monocytogenes during hospitalization. In a retrospective study, serotyping and pulsed-field gel electrophoresis revealed that six isolates were identical or genetically related. Four of them had been isolated from renal transplant recipients. Listeria monocytogenes was neither detected in food samples of the renal transplantation ward, nor in stool specimens obtained from the ward staff. There had been no close contacts among the infected patients. Before transplantation, the renal transplant recipients had been dialysed in different dialysis centers. Nosocomial foodborne transmission could not be proven but seems likely.

Enan G. et al. *Antibacterial activity of Lactobacillus plantarum UG1 isolated from dry sausage: characterization, production and bactericidal action of plantaricin UG1.* Int J Food Microbiol. 1996; 30(3) : 189-215.p Abstract: Lactobacillus plantarum UG1 isolated from dry sausage produced an antimicrobial substance that inhibited other strains of the genera Lactobacillus and Lactococcus, and some foodborne pathogens including Listeria monocytogenes, Bacillus cereus, Clostridium perfringens and Clostridium sporogenes. This antibacterial substance was inactivated by proteolytic enzymes and showed a bactericidal mode of action. Consequently, it was characterized as a bacteriocin, and was designated plantaricin UG1. This bacteriocin was stable in the pH range 4.5 to 7.0, partially inactivated by amylolytic enzymes and relatively thermostable. It was not affected by organic or lipolytic enzymes. Production of plantaricin UG1 was pH- and temperature-dependant and maximum yields were obtained in MRS broth cultures maintained at initial pH 6.5, and incubated at 25 degrees C to 30 degrees C, in the exponential to the early stationary growth phase of the producer organism. Ultrafiltration studies indicated that plantaricin UG1 has a molecular weight between 3 and 10 KDa. Curing experiments with L. plantarum UG1 resulted in the appearance of variants that lost bacteriocin production ability but were still immune to the bacteriocin. Plantaricin UG1 production appeared to be chromosomal encoded. Sensitive and insensitive Gram-positive bacteria adsorbed plantaricin UG1 irrespective of their susceptibility to it. In contrast, Gram-negative bacteria did not adsorb plantaricin UG1. The bactericidal action of plantaricin UG1 did not depend on the physiological state of the indicator culture and did not cause cell lysis. The resistance of two indicator strains to plantaricin UG1 has been studied.

Escartin E.F. et al. *[Poisoning by enterotoxin from Staphylococcus aureus associated with mocha pastry. Microbiology and epidemiology].* Rev Latinoam Microbiol. 1998; 40(1-2) : 25-31.p Abstract: A brief description of a foodborne outbreak due to S. aureus enterotoxin associated with the consumption of mocha cake in the city of Guadalajara is presented. The cake was prepared in a bakery and affected nearly 100 persons. S. aureus was isolated from the nose and skin of one of the pastry cooks. A S. aureus strain isolated from the cake involved in the outbreak was not only unable to grow in the mocha cream, but it actually decreased in numbers by 2 log after 72 h of storage at 30 degrees C. The pH of mocha cream ranged from 6.2 to 6.6, and water activity from 0.833 to 0.859, with a media of 0.841. In preparing mocha cake at the shop, one half of the dough used to be sprayed with a sucrose solution in water (20% w/v); mocha cream was spread on the other half of the dough before overlapping the two halves. When mocha cake was prepared in this manner, and stored at 30 degrees C, S. aureus increased in number by more than 4 log after 48 h. S. aureus did not grow in the cake stored at 4-7 degrees C. Contributory factors in this outbreak were an increase of water activity in the interphase of the mocha and the cake dough, storage of the cake in an unrefrigerated area, and an unusually high ambient temperature (28-32 degrees C) at that time.

Estrada-Garcia T. et al. *Cholera: foodborne transmission and its prevention.* Eur J Epidemiol. 1996; 12(5) : 461-9.p Abstract: The last several years have witnessed a tremendous increase in reported cholera cases across the globe. The explosive arrival of the seventh cholera pandemic in Latin American in 1991, dramatic epidemics of cholera on the Indian subcontinent and in Southeast Asia due to the newly recognized Vibrio cholerae O139 strain, and the often deadly presence of cholera among populations affected by political and social upheaval in Africa and Eastern Europe are evidence that many countries have failed to adopt effective measures for cholera prevention and control. Foodborne transmission of cholera has been well documented by epidemiologic investigations in nearly every continent, and its interruption is a critical component to any integrated programme for cholera prevention and control. We emphasize clear and effective guidelines for the prevention of foodborne cholera transmission that are drawn from a comprehensive review of relevant epidemiologic and laboratory data.

Evans H.S. et al. *General outbreaks of infectious intestinal disease in England and Wales: 1995 and 1996.* Commun Dis Public Health. 1998; 1(3) : 165-71.p Abstract: One thousand nine hundred and nineteen general outbreaks of infectious intestinal disease in England and Wales were reported to the PHLS Communicable Disease Surveillance Centre (CDSC) between 1 January 1995 and 31 December 1996, compared with 1073 in the previous two years. A minimum data set was received for 1568 (82%) of the 1919 outbreaks. Over 40,000 people were affected and about 2% of those who were ill were admitted to hospital. Seventy-one deaths were reported. The duration of outbreaks varied between less than one day and 202 days (median six days) according to the pathogen. Small round structured virus (SRSV) (43%) and salmonellas (15%) were the most commonly reported pathogens. In almost a quarter of the outbreaks (24%) the aetiology was unknown. Over half the outbreaks (64%) were reported to be transmitted from person to person, most of which were due to SRSV and occurred in residential homes and hospitals. Twenty-two per cent of outbreaks were described as mainly foodborne, 51% of which were due to salmonellas. The number of outbreaks reported in each region ranged from 52 in Wales to 512 in Northern and Yorkshire.

Evans H.S. et al. *Outbreaks of infectious intestinal disease in schools and nurseries in England and Wales 1992 to 1994.* Commun Dis Rep CDR Rev. 1996; 6(7) : R103-8.p Abstract: We present data on outbreaks of infectious intestinal disease in schools and nurseries obtained from the surveillance scheme of all general outbreaks of infectious intestinal disease in England and Wales reported to the PHLS Communicable Disease Surveillance Centre between 1992 and 1994. A minimum set of data was received for 1280 outbreaks, 95 of which (7%) arose in schools and nurseries. The commonest pathogens were salmonellas, Shigella sonnei, and small round structured viruses. The mode of transmission was described as mainly from person to person in 55 outbreaks and mainly foodborne in 30. The mean attack rate was 30% and median duration was 10 days. The attack rate and duration varied with the pathogen involved. Forty-five of the 3118 people reported to have been ill were admitted to hospital. Outbreaks in schools and nurseries are common. Attack rates are high and such outbreaks are often prolonged. Effective infection control policies and appropriate training of staff are needed. Good local systems for surveillance can help identify outbreaks quickly and allow control measures to be applied early.

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Farber J.M. *Symposium on microbiology update: old friends and new enemies. Listeria monocytogenes.* J Assoc Off Anal Chem. 1991; 74(4) : 701-4.p Abstract: Listeria monocytogenes, one of the "new enemies" in food microbiology, is a human and animal pathogen that is widespread in nature. The organism is a transient constituent of the intestinal flora excreted by 1-10% of healthy humans. It is an extremely hardy organism and can survive for many years in the cold in naturally infected sources. L. monocytogenes has been isolated from a wide variety of foods, including dairy products, meats, and fish. Although most of the foodborne listeriosis outbreaks have been linked to the consumption of dairy products, recent sporadic cases have been associated with meats, as well as other foods. It is now recognized that listeriolysin 0, a 60-kilodalton protein, is one of the major virulence factors of the organism. All strains of L. monocytogenes are pathogenic by definition although some appear to be more virulent than others. There have been recent reports of hemolytic isolates of L. monocytogenes, which are nonpathogenic for mice. Attachment to and penetration of cells also appear to be prerequisites for human infection. Cultural methodology for isolating the organism from foods has been in a state of flux since 1985. Rapid methods using both ELISA and DNA technology have been developed. Because of the widespread nature of the organism, it is nearly impossible to eliminate it from the food supply. However, by using a hazard analysis-critical control point approach, the health hazard associated with this organism can be reduced to a minimum.

Farber J.M. et al. *A small outbreak of listeriosis potentially linked to the consumption of imitation crab meat.* Lett Appl Microbiol. 2000; 31(2) : 100-4.p Abstract: A small outbreak of listeriosis involving two previously healthy adults occurred in Ontario. Food samples obtained from the refrigerator of the patients included imitation crab meat, canned black olives, macaroni and vegetable salad, spaghetti sauce with meatballs, mayonnaise and water. All of the samples except the water contained Listeria monocytogenes. The three most heavily contaminated samples were the imitation crab meat, the olives and the salad which contained 2.1 x 109, 1.1 x 107 and 1.3 x 106 cfu g-1, respectively. L. monocytogenes serotype 1/2b was isolated from the patients, as well as from the opened and unopened imitation crab meat. Molecular typing of the isolates by both randomly amplified polymorphic DNA (RAPD) and pulsed-field gel electrophoresis (PFGE) typing demonstrated the imitation crab meat and clinical strains to be indistinguishable. Challenge studies performed with a pool of L. monocytogenes strains showed that imitation crab meat, but not olives, supported growth of the organism. In this study we have shown for the first time the potential involvement of imitation crab meat in a small outbreak of listeriosis. In terms of disease prevention, temperature control is critical to prevent or reduce the growth of this foodborne pathogen. In addition, with refrigerated products having a long (> 30 d) shelf life, additional safety factors must be used to prevent the growth of foodborne pathogens such as L. monocytogenes.

Farber J.M. et al. *Listeria monocytogenes, a food-borne pathogen.* Microbiol Rev. 1991; 55(3) : 476-511.p Abstract: The gram-positive bacterium Listeria monocytogenes is an ubiquitous, intracellular pathogen which has been implicated within the past decade as the causative organism in several outbreaks of foodborne disease. Listeriosis, with a mortality rate of about 24%, is

found mainly among pregnant women, their fetuses, and immunocompromised persons, with symptoms of abortion, neonatal death, septicemia, and meningitis. Epidemiological investigations can make use of strain-typing procedures such as DNA restriction enzyme analysis or electrophoretic enzyme typing. The organism has a multifactorial virulence system, with the thiol-activated hemolysin, listeriolysin O, being identified as playing a crucial role in the organism's ability to multiply within host phagocytic cells and to spread from cell to cell. The organism occurs widely in food, with the highest incidences being found in meat, poultry, and seafood products. Improved methods for detecting and enumerating the organism in foodstuffs are now available, including those based on the use of monoclonal antibodies, DNA probes, or the polymerase chain reaction. As knowledge of the molecular and applied biology of L. monocytogenes increases, progress can be made in the prevention and control of human infection.

Farkas J. *Irradiation as a method for decontaminating food. A review.* Int J Food Microbiol. 1998; 44(3) : 189-204.p Abstract: Despite substantial efforts in avoidance of contamination, an upward trend in the number of outbreaks of foodborne illnesses caused by nonsporeforming pathogenic bacteria are reported in many countries. Good hygienic practices can reduce the level of contamination but the most important pathogens cannot presently be eliminated from most farms nor is it possible to eliminate them by primary processing, particularly from those foods which are sold raw. Several decontamination methods exist but the most versatile treatment among them is the processing with ionizing radiation. Decontamination of food by ionizing radiation is a safe, efficient, environmentally clean and energy efficient process. Irradiation is particularly valuable as an endproduct decontamination procedure. Radiation treatment at doses of 2-7 kGy--depending on condition of irradiation and the food--can effectively eliminate potentially pathogenic nonsporeforming bacteria including both long-time recognized pathogens such as Salmonella and Staphylococcus aureus as well as emerging or "new" pathogens such as Campylobacter, Listeria monocytogenes or Escherichia coli O157:H7 from suspected food products without affecting sensory, nutritional and technical qualities. Candidates of radiation decontamination are mainly poultry and red meat, egg products, and fishery products. It is a unique feature of radiation decontamination that it can also be performed when the food is in a frozen state. With today's demand for high-quality convenience foods, irradiation in combination with other processes holds a promise for enhancing the safety of many minimally processed foods. Radiation decontamination of dry ingredients, herbs and enzyme preparations with doses of 3-10 kGy proved to be a viable alternative to fumigation with microbicidal gases. Radiation treatment at doses of 0.15-0.7 kGy under specific conditions appears to be feasible also for control of many foodborne parasites, thereby making infested foods safe for human consumption. Microorganisms surviving low- and medium-dose radiation treatment are more sensitive to environmental stresses or subsequent food processing treatments than the microflora of unirradiated products. Radiation treatment is an emerging technology in an increasing number of countries and more-and-more clearances on radiation decontaminated foods are issued or expected to be granted in the near future.

Farley T.A. et al. *Direct inoculation of food as the cause of an outbreak of group A streptococcal pharyngitis.* J Infect Dis. 1993; 167(5) : 1232-5.p Abstract: An investigation was conducted of a food-related outbreak of group A streptococcal pharyngitis following an elementary school banquet. Of 166 surveyed banquet attendees, 71 (43%) reported outbreak-associated pharyngitis, and 21 (88%) of 24 tested attendees had evidence of group A streptococcus (GAS) in the throat. Attendees who ate macaroni and cheese were three times more likely to develop pharyngitis than those who did not (66/132 [50%] vs. 5/30 [17%], P = .002). None of the food handlers had GAS recovered by throat culture. However, the cook who prepared the macaroni and cheese had a hand wound; a wound culture grew GAS with the same T agglutination pattern and M- and/or opacity factor type as that of all available GAS strains from ill attendees. Under laboratory conditions, macaroni and cheese supported rapid growth of the outbreak-associated strain of GAS. To the authors' knowledge, this is the first documented foodborne outbreak of GAS pharyngitis in which the only apparent source of contamination was a food handler's skin lesion.

Farrell G.M. et al. *Borrelia burgdorferi: another cause of foodborne illness?* Int J Food Microbiol. 1991; 14(3-4) : 247-60.p Abstract: Borrelia burgdorferi was identified as the etiological agent of Lyme disease in 1982. This Gram-negative spirochete is classified in the order Spirochaetales and the family Spirochaetaceae. The pathogen is fastidious, microaerophilic, mesophilic and metabolises glucose through the Embden-Meyerhof pathway. A generation time of 11 to 12 h at 37 degrees C in Barbour-Stoenner-Kelly medium has been reported. Lyme disease, named after Lyme in Connecticut, is distributed globally. It is the most commonly reported vector-borne disease in the United States, where the incidence is highest in the eastern and midwestern states. Since establishment of national surveillance in 1982, there has been a nine-fold increase in the number of cases reported to the U.S. Centers for Disease Control. The deer tick of the genus Ixodes is the primary vector of Lyme borreliosis. The tick may become infected with B. burgdorferi, by feeding on an infected host, at any point in its 2-year life cycle which involves larval, nymphal and adult stages. The infection rate in deer ticks may be as high as 40% in endemic areas. The primary vertebrate reservoirs for Ixodes are the white-footed mouse (Peromyscus leucopus) and the white-tailed deer (Odocopileus virginianus). Dairy cattle and other food animals can be infected with B. burgdorferi and hence some raw foods of animal origin might be contaminated with the pathogen. Recent findings indicate that the pathogen may be transmitted orally to laboratory animals, without an arthropod vector. Thus, the possibility exists

that Lyme disease can be a food infection. In humans, the symptoms of Lyme disease, which manifest themselves days to years after the onset of infection, may involve the skin, cardiac, nervous and/or muscular systems, and so misdiagnosis can occur.

Feijoo S.C. et al. *Effect of storage temperatures and ingredients on growth of Bacillus cereus in coffee creamers.* J Dairy Sci. 1997; 80(8) : 1546-53.p Abstract: Growth of Bacillus cereus ATCC 33018 was evaluated in half and half (10.5% fat), whipping cream (30% fat), and nondairy creamer (7.5% fat). Samples were inoculated with approximately 10 vegetative cells/ml or 100 spores/ml and were subsequently stored at 4, 7, 23 and 32 degrees C. Within 9 h at 32 degrees C and 11 h at 23 degrees C, in both half and half and whipping cream, vegetative cells and spores reached population levels that can cause foodborne illness. No growth occurred in any product stored at 4 or 7 degrees C. Sodium stearoyl lactylate, a fatty acid derivative that is used as an emulsifier, inhibited growth of spores and vegetative cells in the nondairy creamers stored at either 32 or 23 degrees C.

Feldhusen F. *[Seafood transmitted diseases]*. DTW Dtsch Tierarztl Wochenschr. 1999; 106(8) : 319-25.p Abstract: This paper reviews seafood related bacterial, viral and parasitological hazards for consumers worldwide. Seafood from Europe is generally regarded as safe. Food safety risks associated with aquaculture products results from contamination with biological agents, which are greater in freshwater and coastal ecosystems than in open seas. Due to the consumption conditions and the intensive investigations of imported products with contamination of pathogenic bacteria there are little seafood risks in Europe. Viral infections are associated with consumption of raw or recontaminated shellfish. There has been speculation that more than 50% of the outbreaks of unknown aethiology are due to viruses. Foodborne parasitic hazards are associated with the consumption of raw (sushi) or insufficiently heated, marinated and salted seafood.

Feng P. *Emergence of rapid methods for identifying microbial pathogens in foods.* J AOAC Int. 1996; 79(3) : 809-12.p Abstract: Because of the complexities of food analysis, conventional microbiological methods must use time-consuming enrichment steps for culturing viable bacterial cells in foods. With rapid advancements in technology, however, numerous so-called rapid methods were introduced into the field of food microbiology in a relatively short time. Culture methods that were once used to obtain profiles for bacterial identification were simplified or automated. Many microbiological procedures were also streamlined or automated to reduce assay time, labor, and materials. Nucleic acid-based assays are used to identify gene sequences in foodborne bacteria, and antibody-based assays are used in numerous formats to detect bacterial pathogens and toxins in foods. The difficulties of analyzing food, however, remain challenging, and rapid methods need to be evaluated thoroughly before they are used for routine food analysis.

Feng P. *Escherichia coli serotype O157:H7: novel vehicles of infection and emergence of phenotypic variants.* Emerg Infect Dis. 1995; 1(2) : 47-52.p Abstract: Escherichia coli serotype O157:H7 was only recognized as a human pathogen a little more than a decade ago, yet it has become a major foodborne pathogen. In the United States, the severity of serotype O157:H7 infections in the young and the elderly has had a tremendous impact on human health, the food industry, and federal regulations regarding food safety. The implication of acidic foods as vehicles of infection has dispelled the concept that low-pH foods are safe. Further, the association of nonbovine products with outbreaks suggests that other vehicles of transmission may exist for this pathogen. In laboratory diagnosis, most microbiologic assays rely on a single phenotype to selectively isolate this pathogen. However, the increasing evidence that phenotypic variations exist among isolates in this serogroup may eventually necessitate modifications in assay procedures to detect them.

Feng P. *Impact of molecular biology on the detection of foodborne pathogens.* Mol Biotechnol. 1997; 7(3) : 267-78.p Abstract: Molecular biological methods that use antibodies and nucleic acids to detect specific foodborne bacterial pathogens were scarcely known a decade and a half ago. Few scientists could have predicted that these tools of basic research would come to dominate the field of food diagnostics. Today, a large number of cleverly designed assay formats using these technologies are available commercially for the detection in foods of practically all major established pathogens and toxins, as well as of many emerging pathogens. These tests range from very simple antibody-bound latex agglutination assays to very sophisticated DNA amplification methods. Although molecular biological assays are more specific, sensitive, and faster than conventional (often cultural) microbiological methods, the complexities of food matrices continue to offer unique challenges that may preclude the direct application of these molecular biological methods. Consequently, a short cultural enrichment period is still required for food samples prior to analysis with these assays. The greater detection sensitivity of molecular biological methods may also affect existing microbiological specifications for foods; this undoubtedly will have repercussions on the regulatory agencies, food manufacturers, and also consumers.

Fermanian C. et al. *Diarrhoeal toxin production at low temperature by selected strains of Bacillus cereus.* J Dairy Res. 1997; 64(4) : 551-9.p Abstract: The growth of four Bacillus cereus strains producing diarrhoeal toxin at 32 degrees C (F4433/73 and 29.155, isolated on the occasion of foodborne outbreaks, and F4581/76L and F4581/76R, two variants of a clinical strain), a weakly toxigenic strain isolated in routine analysis of food (3505M) and an emetic isolate (F3502/73) was investigated at low temperature.

Biomass was determined by protein assay. Generation times were: for strain F3502/73, which grew at > or = 12 degrees C, 8.71 h (at 12 degrees C); for other strains, which grew at > or = 10 degrees C, 10.2 to approximately 18.9 h (at 10 degrees C). Toxin production during growth was evaluated by a commercial kit (Oxoid) and by a toxicity test on Chinese hamster ovary cells. Strains F4433/73 and F4581/76, secreting high levels of diarrhoeal toxin during the exponential phase at 32 degrees C, produced high levels of toxicity at 10 degrees C until the stationary phase. Strain 29.155 had decreased toxin production at 10 degrees C. Toxicities for cellular extracts remained low when compared with culture filtrates. A correlation was found between the toxicity values given by the two detection methods tested, and the suitability of both methods for the detection of potential poisoning isolates is discussed.

Filtenborg O. et al. *Moulds in food spoilage.* Int J Food Microbiol . 1996; 33(1) : 85-102.p Abstract: There is an increasing knowledge and understanding of the role played by moulds in food spoilage. Especially the discovery of mycotoxin production in foods has highlighted the importance of moulds in food quality. It is, however, only within the last 5-10 years that major progresses have been made towards the prevention of spoilage caused by moulds. This is due to recent international agreements on taxonomy and analytical methods for foodborne moulds, which has led to the discovery, that a specific, very limited funga (= mycobiota) is responsible for the spoilage of each kind of food. This is called the associated or critical funga and has been shown to consist of less than ten species. In this paper the associated funga is described for the following foods: citrus and pomaceous fruit, potato and yam tubers, onions, rye, wheat, rye bread, cheese and fermented sausage and whenever possible the selective principle of the food is discussed. In the description only references which are using the new taxonomy and mycological methods have been used. The individual fungas are very different from each other, which again means that the potential appearance of a specific mycotoxin is restricted to a limited number of foods. The important mycotoxin pattern of each food is described including toxins which originate from 'carry over'. For some foods examples are also given on spoilage of sensoric properties due to moulds. Finally, preventive action against the growth of the associated funga is described for some of the foods and it is concluded that optimization of the prevention and control of moulds in foods must be based on knowledge of the associated funga.

Fischhoff B. et al. *Communicating foodborne disease risk.* Emerg Infect Dis. 1997; 3(4) : 489-95.p Abstract: The food industry, like many others, has a risk communication problem. That problem is manifested in the public's desire to know the truth about outbreaks of foodborne diseases; ongoing concern about the safety of foods, additives, and food-processing procedures; and continued apathy regarding aspects of routine food hygiene. If these concerns are addressed in a coherent and trustworthy way, the public will have better and cheaper food. However, sloppy risk communication can itself cause public health damage. Because citizens are ill-equipped to discriminate among information sources, the food industry as a whole bears responsibility for the successes and failures of its individual members. We review risk communication research and practice for their application to the food industry.

Flaxman S.M. et al. *Morning sickness: a mechanism for protecting mother and embryo.* Q Rev Biol. 2000; 75(2) : 113-48.p Abstract: Approximately two-thirds of women experience nausea or vomiting during the first trimester of pregnancy. These symptoms are commonly known as morning sickness. Hook (1976) and Profet (1988) hypothesized that morning sickness protects the embryo by causing pregnant women to physically expel and subsequently avoid foods that contain teratogenic and abortifacient chemicals, especially toxic chemicals in strong-tasting vegetables, caffeinated beverages and alcohol. We examined this hypothesis by comprehensively reviewing the relevant medical, psychological and anthropological literature. In its support, (i) symptoms peak when embryonic organogenesis is most susceptible to chemical disruption (weeks 6-18), (ii) women who experience morning sickness are significantly less likely to miscarry than women who do not (9 of 9 studies), (iii) women who vomit suffer fewer miscarriages than those who experience nausea alone, and (iv) many pregnant women have aversions to alcoholic and nonalcoholic (mostly caffeinated) beverages and strong-tasting vegetables, especially during the first trimester. Surprisingly, however, the greatest aversions are to meats, fish, poultry, and eggs. A cross-cultural analysis using the Human Relations Area Files revealed 20 traditional societies in which morning sickness has been observed and seven in which it has never been observed. The latter were significantly less likely to have animal products as dietary staples and significantly more likely to have only plants (primarily corn) as staples than the 20 societies in which morning sickness occurred. Animal products may be dangerous to pregnant women and their embryos because they often contain parasites and pathogens, especially when stored at room temperatures in warm climates. Avoiding foodborne microorganisms is particularly important to pregnant women because they are immunosuppressed, presumably to reduce the chances of rejecting tissues of their own offspring (Haig 1993). As a result, pregnant women are more vulnerable to serious, often deadly infections. We hypothesize that morning sickness causes women to avoid foods that might be dangerous to themselves or their embryos, especially foods that, prior to widespread refrigeration, were likely to be heavily laden with microorganisms and their toxins. The alternative hypotheses that morning sickness is (i) an epiphenomenon of mother-offspring genetic conflict or hormones associated with viable pregnancies, or (ii) an indicator to potential sexual partners and kin that the woman is pregnant, resulting in reduced sexual behavior and increased nepotistic aid, were not well supported. Available data are most consistent with the hypothesis that morning sickness serves an adaptive, prophylactic function.

Fleche C. *[Risk of disseminating apiary diseases by international movements of bees and their products]*. Rev Sci Tech. 1997; 16(1) : 177-86.p Abstract: The evaluation of the risks of spreading bee diseases is based on information obtained from a wide variety of sources: reports of the world distribution of pathogenic agents; trade flow in bees and bee products; and observations and experimental data on the diseases. At present, this information is severely lacking and only enables a brief outline of trends to be made. Current data are inadequate to prevent the spread of diseases from one country to another. To improve this situation, it is important that exporting countries establish epidemiological and health surveillance practices based on harmonised procedures and diagnostic tests. In addition, the products of apiculture should be given a permanent, specific nomenclature, drawn up by the World Trade Organisation.

Fleet G.H. et al. *Foodborne viral illness--status in Australia.* Int J Food Microbiol. 2000; 59(1-2) : 127-36.p Abstract: Norwalk-like virus contamination of oysters and orange juice, and hepatitis A virus contamination of oysters have been responsible for large outbreaks of foodborne viral disease in Australia. Rotavirus, adenovirus, astrovirus, parvovirus and other enteroviruses also contribute to the incidence of gastroenteritis in this country but the role of foods and waters in transmitting these viruses is unclear. Protocols for the investigation, surveillance and reporting of foodborne viral illness require further development to enable a more accurate description of the problem. Few laboratories have the capability to analyse foods for viruses and specific training in this technology is needed. Management of food safety in Australia largely relies on the implementation of HACCP principles, but these need to be adapted to address the specific risks from viruses.

Fleming C.A. et al. *A foodborne outbreak of Cyclospora cayetanensis at a wedding: clinical features and risk factors for illness.* Arch Intern Med. 1998; 158(10) : 1121-5.p Abstract: BACKGROUND: Cyclospora cayetanensis, a coccidian parasite, has increasingly been recognized as a cause of gastrointestinal tract illness. We describe an outbreak of Cyclospora infection following a wedding reception. OBJECTIVES: To investigate and characterize risk factors associated with the outbreak of Cyclospora and to describe the observed clinical course and spectrum of illness. METHODS: Retrospective cohort study involving 94 of the 101 guests who attended a wedding reception at a restaurant in Boston, Mass. RESULTS: Fifty-seven respondents met the case definition of infection; 12 of these had laboratory-confirmed Cyclospora. The epidemic curve was consistent with a point source outbreak with a median incubation period of 7 days. Commonly reported symptoms included diarrhea (100%), weight loss (93%), fatigue (91%), and anorexia (90%). The illness had a characteristic waxing and waning course, with 51 persons (89%) reporting recurring symptoms and 35 (61%) reporting illness lasting more than 3 weeks. By univariate analysis, infection was significantly associated (P<.05) with consumption of wine and a dessert containing raspberries, strawberries, blackberries, and blueberries. Only the dessert remained significant by stratified analysis with an adjusted relative risk of 2.1 (95% confidence interval, 1.4-3.2). CONCLUSIONS: Findings from this study support a point source outbreak of the newly identified pathogen C cayetanensis, with berries as the vehicle of transmission. It suggests that Cyclospora may cause severe diarrhea associated with profound anorexia and weight loss, and should be considered in the evaluation of prolonged gastrointestinal tract illness.

Fonberg-Broczek M. et al. *[Level of histamine and tyramine in ripening cheeses]*. Rocz Panstw Zakl Hig. 1995; 46(3) : 243-6.p Abstract: Histamine poisoning is a foodborne chemical intoxication resulting from the ingestion of food products containing high levels of histamine. Historically, histamine poisoning has been attributed to the consumption of fish species belonging to the Scomberesocidae and Scombridae families and other sea fish, but histamine poisoning outbreaks may occur after the consumption of cheese, or other types of fermented foods. Also tyramine has been proved as a cause of adverse reactions, involving headache, hypertensive crisis and interactions with antidepressive drugs, which were observed after consumption of ripening cheeses. The formation of high levels of histamine and tyramine in foods is directly correlated to the level of microorganisms, possessing the enzymes: histidine and tyrozyne decarboxylases, and also with the concentration of histidine and tyrosine free substrate. Proteolysis, which takes place during ripening of cheeses may play role in the release of free histidine and tyrosine. This study reports on the levels of histamine and tyramine in ripening cheeses taken from Polish food market. 43 samples of soft and hard cheeses were investigated. Histamine was measured according to the AOAC fluorometric method. Tyramine was measured after column separation and purification, according to the spectrofluorometric technique with 1-nitroso-2-ortophtalate aldehyde, according to Carou with couple of modifications by authors. Histamine levels ranged from 0 to 157 mg/kg and tyramine levels ranged from 3.8 to 575 mg/kg. The very high levels of histamine and tyramine in many samples of cheeses support the opinion, that sometimes the storage temperature has not been sufficient to stop bacterial multiplication and in consequence enzymatic activity of decarboxylases of native amino acids--precursors of biogenic amines in ripening cheeses.

Fone D.L. et al. *Investigation of an outbreak of gastroenteritis at a hospital for patients with learning difficulties.* Commun Dis Public Health. 1999; 2(1) : 35-8.p Abstract: Eighty of the 460 patients and staff (attack rate 22%) in a long-stay hospital for patients with learning difficulties became ill in a general outbreak of gastrointestinal infection that followed a buffet style party on one ward. Illness in the cohort of 47 resident patients, relations, and staff who attended that party was associated with having eaten ham, coleslaw, bread rolls, and cheese and pineapple on sticks. Food from the hospital kitchen was supplemented by food brought in and prepared on the ward

by staff and patients. The investigation suggested that food items were contaminated either during preparation by staff and patients or during the party when people served themselves. Microbiological and virological investigations were negative, but small round structured virus was thought to be responsible. Hospitals could do more to prevent outbreaks of foodborne infection by undertaking risk assessment as required by the Food Safety Act (General Food Hygiene) Regulations 1995. Purchasers of hospital infection control should ensure compliance with this legislation.

Forsythe R.H. *Food safety: a global perspective.* Poult Sci. 1996; 75(12) : 1448-54.p Abstract: The health of the population of the U.S. is affected by many factors, not the least of which is its food supply. A major source of high quality animal protein comes from poultry, eggs, and meat. The major effect of personal habits and the environment, diet, tobacco, alcohol, are considered, along with the microbiological effect on foodborne illness and health. The inspection system for meat and poultry is reviewed, in light of the publication of significant revisions being instituted at this time. The role of research, regulatory reform, and political science is considered as supportive of food service and consumer education. Education of food service workers, institutional employees, and consumers is a responsibility that the land grant universities should take very seriously. Networking with associations like the National Restaurant Association and its regional affiliates will be invaluable in improving the health of the people of the U.S.

Foster E.M. *Historical overview of key issues in food safety.* Emerg Infect Dis. 1997; 3(4) : 481-2.p Abstract: Foodborne transmission of pathogenic and toxigenic microorganisms has been a recognized hazard for decades. Even half a century ago we knew about the dangers of botulism from underprocessed canned foods; staphylococcal poisoning from unrefrigerated cream-filled pastries, sliced ham, meat, and poultry salads; and salmonellosis from infected animal products. Despite new protective measures, changes in preservation techniques and failure to follow recognized procedures have created new dangers. Moreover, we now recognize new organisms that can cause foodborne illness--Listeria monocytogenes, Escherichia coli O157:H7, Campylobacter jejuni, Vibrio parahaemolyticus, Yersinia enterocolitica, and others. Controlling these organisms will require widespread education and possibly new regulatory initiatives.

Franciosa G. et al. *Clostridium botulinum spores and toxin in mascarpone cheese and other milk products.* J Food Prot. 1999; 62(8) : 867-71.p Abstract: A total of 1,017 mascarpone cheese samples, collected at retail, were analyzed for Clostridium botulinum spores and toxin, aerobic mesophilic spore counts, as well as pH, a(w) (water activity), and Eh (oxidation-reduction potential). In addition 260 samples from other dairy products were also analyzed for spores and botulinum toxin. Experiments were carried out on naturally and artificially contaminated mascarpone to investigate the influence of different temperature conditions on toxin production by C. botulinum. Three hundred and thirty-one samples (32.5%) of mascarpone were positive for botulinal spores, and 7 (0.8%) of the 878 samples produced at the plant involved in an outbreak of foodborne botulism also contained toxin type A. The chemical-physical parameters (pH, a(w), Eh) of all samples were compatible with C. botulinum growth and toxinogenesis. Of the other milk products, 2.7% were positive for C. botulinum spores. Growth and toxin formation occurred in naturally and experimentally contaminated mascarpone samples after 3 and 4 days of incubation at 28 degrees C, respectively.

Frank S.A. *Models of parasite virulence.* Q Rev Biol. 1996; 71(1) : 37-78.p Abstract: Several evolutionary processes influence virulence, the amount of damage a parasite causes to its host. For example, parasites are favored to exploit their hosts prudently to prolong infection and avoid killing the host. Parasites also need to use some host resources to reproduce and transmit infections to new hosts. Thus parasites face a tradeoff between prudent exploitation and rapid reproduction-a life history tradeoff between longevity and fecundity. Other tradeoffs among components of parasite fitness also influence virulence. For example, competition among parasite genotypes favors rapid growth to achieve greater relative success within the host. Rapid growth may, however, lower the total productivity of the local group by overexploiting the host, which is a potentially renewable food supply. This is a problem of kin selection and group selection. I summarize models of parasite virulence with the theoretical tools of life history analysis, kin selection, and epidemiology. I then apply the theory to recent empirical studies and models of virulence. These applications, to nematodes, to the extreme virulence of hospital epidemics, and to bacterial meningitis, show the power of simple life history theory to highlight interesting questions and to provide a rich array of hypotheses. These examples also show the kinds of conceptual mistakes that commonly arise when only a few components of parasite fitness are analysed in isolation. The last part of the article connects standard models of parasite virulence to diverse topics, such as the virulence of bacterial plasmids, the evolution of genomes, and the processes that influenced conflict and cooperation among the earliest replicators near the origin of life.

Franz C.M. et al. *Enterococci at the crossroads of food safety?* Int J Food Microbiol. 1999; 47(1-2) : 1-24.p Abstract: Enterococci are gram-positive bacteria and fit within the general definition of lactic acid bacteria. Modern classification techniques resulted in the transfer of some members of the genus Streptococcus, notably some of the Lancefield's group D streptococci, to the new genus Enterococcus. Enterococci can be used as indicators of faecal contamination. They have been implicated in outbreaks of foodborne illness, and they have been ascribed a beneficial or detrimental role in foods. In processed meats, enterococci may survive heat processing and cause

spoilage, though in certain cheeses the growth of enterococci contributes to ripening and development of product flavour. Some enterococci of food origin produce bacteriocins that exert anti-Listeria activity. Enterococci are used as probiotics to improve the microbial balance of the intestine, or as a treatment for gastroenteritis in humans and animals. On the other hand, enterococci have become recognised as serious nosocomial pathogens causing bacteraemia, endocarditis, urinary tract and other infections. This is in part explained by the resistance of some of these bacteria to most antibiotics that are currently in use. Resistance is acquired by gene transfer systems, such as conjugative or nonconjugative plasmids or transposons. Virulence of enterococci is not well understood but adhesins, haemolysin, hyaluronidase, aggregation substance and gelatinase are putative virulence factors. It appears that foods could be a source of vancomycin-resistant enterococci. This review addresses the issue of the health risk of foods containing enterococci.

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Gallay A. et al. *How many foodborne outbreaks of Salmonella infection occurred in France in 1995? Application of the capture-recapture method to three surveillance systems.* Am J Epidemiol. 2000; 152(2) : 171-7.p Abstract: Despite control measures, foodborne outbreaks of non-typhi Salmonella infection continue to occur in developed countries. The authors aimed to assess the number of foodborne Salmonella outbreaks that occurred in France in 1995 using a capture-recapture approach. Data from three sources--the National Public Health Network (NPHN), the Ministry of Agriculture (MA), which receives mandatory notification, and the National Salmonella and Shigella Reference Center (NRC)-were collected. Matching algorithms permitted identification of matched outbreaks. The total number of outbreaks was estimated by log-linear modeling taking into account source dependencies and the variable catchability. The final estimate was adjusted for the positive predictive value (66%) of the NRC case definition. The dependence between the NPHN and the MA was also evaluated by means of a qualitative survey. A total of 716 foodborne Salmonella outbreaks were reported to the three sources, and 108 matches were identified. The best-fitting model, taking into account a positive dependence between the NPHN and MA sources, gave an estimate of 757 outbreaks. The sensitivity was 15% for the NPHN, 10% for the MA, and 50% for the NRC. In France, routine mandatory reporting of foodborne Salmonella outbreaks is very incomplete, and it is not representative of the serotype and the type of outbreak.

Gamble H.R. et al. *Detection of parasites in food.* Parasitology. 1998; 117 Suppl : S97-111.p Abstract: The importance of foodborne parasitic zoonoses remains high in many regions of the world. Although control efforts have been exerted for quite some time, overall progress has not been satisfactory, even in many well developed countries. An important drawback in control programmes for parasites such as Trichinella, Toxoplasma and Taenia has been the absence of rapid, accurate and sensitive diagnostic tests for these meatborne parasites. However, the rapid advances in the molecular biology of these organisms has yielded concomitant gains in precision of detection. This review highlights these advances and their impact or potential application to the control of foodborne parasites.

Gamble H.R. et al. *Effects of hydrodynamic pressure on the viability of Trichinella spiralis in pork.* J Food Prot. 1998; 61(5) : 637-9.p Abstract: Treatment by hydrodynamic pressure is an attractive alternative for meat tenderization and might also have an effect on foodborne pathogens. Numbers of Trichinella spiralis recovered from infected pork were significantly reduced by treatment with the Hydrodyne process, as compared with untreated, infected pork. However, treatment with the hydrodynamic force described in this paper (55 to 60 MPa) did not eliminate the infectivity of this parasite when the larvae from Hydrodyne-treated meat were inoculated into mice.

Garcia-Lopez M.L. et al. *[Incidence, behavior and control of Aeromonas hydrophila in meat and dairy products].* Microbiologia. 1993; 9 Spec No : 49-56.p Abstract: This review deals with several aspects of Aeromonas hydrophila and other motile Aeromonas species associated with foodborne illness. Although it is mainly dedicated to the factors affecting growth and survival of this species in foods of animal origin, information on other topics is also provided. This paper includes sections on: Taxonomy, diseases caused by Aeromonas, virulence factors, reservoirs and prevalence in foods and water, factors affecting growth and survival, isolation and identification, and control measures.

Garver K.I. et al. *Detection, identification and characterization of bacteriocin-producing lactic acid bacteria from retail food products.* Int J Food Microbiol. 1993; 19(4) : 241-58.p Abstract: Forty bacteriocin-producing (Bac+) lactic acid bacteria (LAB) were isolated from food samples purchased from retail supermarkets and local farms. Of the 40 Bac+ isolates, 18 were isolated from 85 food samples by enrichment (21% isolation rate) whereas eight were obtained from 63 samples by direct plating (13% isolation rate). By direct plating, Bac+ LAB were detected at levels up to 2.4 x 10(5) cfu/g in ready-to-eat meats. The Bac+ isolates were identified by carbohydrate fermentation patterns, SDS-PAGE protein patterns, and other biochemical characteristics; SDS-PAGE proved invaluable in identifying strains that could not be identified by other means. Differential inhibitory spectra against indicator microorganisms assisted in the identification of 19 unique Bac+ isolates. Bac+ LAB included Enterococcus faecalis, Lactobacillus curvatus, Lb. delbrueckii, Lb. plantarum, Lactococcus lactis, and Pediococcus acidilactici. Lb. curvatus (four strains) and Lc. lactis (nine strains) were the only isolates inhibitory to foodborne pathogens including Listeria monocytogenes, Bacillus cereus, Clostridium perfringens and Staphylococcus aureus. Some Lc. lactis isolates inhibited as many as nine Gram-positive genera.

Lb. curvatus FS47 and FS65 grew to high cell densities and produced bacteriocin at 6 degrees C; however, Lc. lactis FS56 produced greater levels of bacteriocin at lower cell densities. The high incidence of Bac+ LAB detected in retail foods indicates that the public is consuming a wide variety of Bac+ LAB that occur as natural contaminants. These data suggest a greater role for bacteriocins as biopreservatives in food.

Gendel S.M. et al. *Ribotype analysis of strain distribution in Listeria monocytogenes.* J Food Prot. 2000; 63(2) : 179-85.p Abstract: Changes in the temporal and spatial patterns of strain distribution for the foodborne pathogen Listeria monocytogenes were studied by ribotyping using the Qualicon Riboprinter system. Ribotype patterns were obtained by using the restriction enzymes EcoRI and PvuII for 72 isolates of L. monocytogenes recovered from smoked salmon samples over a period of 3 years. Each pattern was classified both by comparison to a pattern library and by comparison among the 72 isolate patterns. Eleven EcoRI-based ribogroups and 16 PvuII groups were identified. Eight of the 11 EcoRI ribogroups were found in isolates obtained over a period of >12 months, and 75% of the EcoRI ribogroups that were found in more than one food sample were distributed nationally. Within the set of isolates, there were 26 instances where more than one isolate was obtained from a single food sample. In 35% of these instances, the co-isolates produced different ribotype patterns, indicating that multiple strains of L. monocytogenes commonly coexist in the same environment. Overall, these data indicate that the population of L. monocytogenes consists of a number of widely dispersed strains with little geographic or temporal stratification.

Gerba C.P. et al. *Sensitive populations: who is at the greatest risk?* Int J Food Microbiol. 1996; 30(1-2) : 113-23.p Abstract: The purpose of this article was to review the existing literature to define those groups of individuals who would be at the greatest risk of serious illness and mortality from water and foodborne enteric microorganisms. This group was found to include the very young, the elderly, pregnant women, and the immunocompromised. This segment of the population currently represents almost 20% of the population in the United States and is expected to increase significantly by the beginning of the next century, because of increases in life-span and the number of immunocompromised individuals. More than half of documented deaths from gastroenteritis and hepatitis A illness occur in the elderly in developed countries. The overall case fatality ratio for foodborne bacterial gastroenteritis outbreaks in nursing homes is 10 times greater than the general population. Pregnant mothers suffer from a case fatality ratio from hepatitis E infections ten times greater than the general population during waterborne disease outbreaks. Enteric diseases are most common and devastating among the immunocompromised. Cryptosporidium is a serious problem among patients with acquired immuno-deficiency syndrome (AIDS). Cancer patients undergoing chemotherapy and transplant patients, are also at significantly greater risk of dying from enteric viral infections than the general population. This review indicates the need for consideration of enhanced protection for certain segments of the population who will suffer the most from food and waterborne pathogens.

Giamalva J.N. et al. *Dietitians employed by health care facilities preferred a HACCP system over irradiation or chemical rinses for reducing risk of foodborne disease.* J Am Diet Assoc. 1998; 98(8) : 885-8.p Abstract: OBJECTIVE: To survey dietitians in health care facilities about the acceptability of alternative meat and poultry processing methods designed to reduce the risk of foodborne disease and their willingness to pay for these processes. SUBJECTS: A geographically representative sample of 600 members of The American Dietetic Association who work in health care facilities. The response rate was 250 completed questionnaires from 592 eligible subjects (42%). DESIGN: A mail survey was used to gather information on the acceptability of a Hazard Analysis and Critical Control Point (HACCP) system, chemical rinses, and irradiation for increasing the safety of food. Discrete choice contingent valuation was used to determine the acceptability at current prices and at 5, 10, and 25 cents per pound above current prices. STATISTICAL ANALYSES: Logistic regression was used to estimate mean willingness to pay (the maximum amount respondents are willing to pay) for each process. A simultaneous equations regression model was used to estimate the effects of other variables on acceptability. RESULTS: Respondents expressed a high level of concern for food safety in health care facilities. The estimated mean willingness to pay was highest for a HACCP system and lowest for chemical rinses. CONCLUSIONS/APPLICATIONS: The successful adoption of alternative methods to increase food safety depends on their acceptance by foodservice professionals. The professionals sampled were most accepting of a HACCP system, somewhat less accepting of irradiation, and least accepting of new chemical rinses. Poultry and beef processors and government agencies concerned with food safety may want to take into account the attitudes of foodservice professionals.

Glass K.A. et al. *Survival of bacterial pathogens in pasteurized process cheese slices stored at 30 degrees C.* J Food Prot. 1998; 61(3) : 290-4.p Abstract: Six lots of commercial pasteurized process cheese slices were evaluated for the ability to support the growth of four foodborne pathogens, Listeria monocytogenes, Staphylococcus aureus, Salmonella serotypes, and Escherichia coli O157:H7, during 4 days of storage at 30 degrees C. Individual cheese slices were inoculated separately with each pathogen to yield ca. 10(3) CFU/g. Slices were packaged in sterile plastic sample bags and stored at 30 degrees C for up to 96 h. Population of Salmonella serotypes and Escherichia coli O157:H7 decreased an average of 1.3 and 2.1 log10 CFU/g, respectively, by 36 h and Salmonella serotypes decreased an additional 0.6 log10 CFU/g during the remaining 60 h. Populations of Listeria monocytogenes also decreased,

although to a lesser extent, exhibiting approximately a 0.6-log10 CFU/g reduction in 96 h. Staphylococcus aureus levels remained relatively constant during the testing period, and were below levels that support detectable enterotoxin production. The process cheese slices tested allowed survival but did not support rapid growth of S. aureus, whereas populations of L. monocytogenes, E. coli O157:H7, and Salmonella serotypes decreased during the 96-h storage at 30 degrees C.

Gomez T.M. et al. *Foodborne salmonellosis.* World Health Stat Q. 1997; 50(1-2) : 81-9.p Abstract: Foodborne diseases caused by non-typhoid Salmonella are a very important public health problem and an economic burden in many parts of the world. Salmonellosis data from the WHO Global Databank on Foodborne Disease, from the literature and from the WHO Surveillance Programme in Europe were reviewed for the years 1985-1995, showing an apparent increase in the incidence of salmonellosis in many parts of the world. In industrialized countries, this increase may be due to the emergence and increase of S. enteritidis and S. typhimurium DT104. In order to reduce the incidence of human foodborne salmonellosis, measures should be taken simultaneously during the production, processing, distribution, retail marketing and handling/preparation of food to prevent the introduction of Salmonella and its multiplication. These control measures need to be supported by effective foodborne disease surveillance programmes which make it possible to recognize and investigate outbreaks and emerging pathogens, and to assess the need for and evaluate interventions by monitoring longer term trends.

Goodman L.J. et al. *Evaluation of an outbreak of foodborne illness initiated in the emergency department.* Ann Emerg Med. 1993; 22(8) : 1291-4.p Abstract: STUDY OBJECTIVES: For many foodborne outbreaks, the pathogen and food vehicle never are identified. Delayed collection of epidemiologic and microbiologic information may contribute to this. We postulated that collection of this information from ill persons as they presented to the emergency department during a recent outbreak might contribute to earlier identification of the pathogen and vehicle. DESIGN: At least 690 of 1,900 conventioneers developed gastrointestinal symptoms after attending a banquet. A questionnaire was developed to collect information on specific food histories, incubation periods, symptoms, physical findings, and demographics. These results were compared with results of investigations by the city and state departments of public health. SETTING: The ED of Rush-Presbyterian-St Luke's Medical Center, a tertiary care university hospital in Chicago, Illinois. TYPE OF PARTICIPANTS: Adults (24 men and nine women) presenting to the ED with gastrointestinal symptoms after eating a common meal. MEASUREMENTS AND MAIN RESULTS: The clinical syndrome suggested an invasive pathogen. Based on this, clinical microbiology laboratory procedures were modified (isolation plates were reviewed during the evening shift). This led to early identification of the first isolates (Salmonella enteritidis) from the outbreak. The questionnaire also narrowed the vehicle to one of two foods served. Investigations by the departments of public health subsequently identified one of these, bread pudding with a raw egg based-sauce, as the vehicle. CONCLUSION: Outbreak evaluations can begin in the ED or any other patient care facility. This evaluation need not always add significantly to the expenditure of time, manpower, or laboratory studies. The evaluation of even a small percentage of ill persons from a large outbreak may provide useful epidemiologic information and be particularly important in settings with limited public health resources.

Gordon S.M. et al. *Foodborne Snow Mountain agent gastroenteritis with secondary person-to-person spread in a retirement community.* Am J Epidemiol. 1990; 131(4) : 702-10.p Abstract: A variety of small round-structured viruses are being recognized with increasing frequency as a cause of gastroenteritis in the community, but have rarely been reported to cause outbreaks in hospitals or extended-care facilities. From March 20 through April 15, 1988, an outbreak of gastroenteritis occurred in a retirement facility in the San Francisco Bay area. Illness was characterized by diarrhea, nausea, and vomiting; two residents died. Attack rates were 46% (155 of 336) in residents and 37% (28 of 75) in employees. During the initial outbreak period, illness among residents was associated with two shrimp meals served in the facility dining hall (odds ratio = 6.7). Person-to-person transmission probably occurred: The risk of becoming ill one or two days after a roommate became ill was significantly greater than that of becoming ill at other times during the outbreak (risk ratio = 6.5). Microbiologic examinations for bacterial and parasitic enteric pathogens were negative; however, 27-nm viral particles were detected by immune electron microscopy and by blocking enzyme immunoassay to Snow Mountain agent in stools obtained at the onset of illness from one of six ill residents. Seroconversion (greater than fourfold antibody rise) to Snow Mountain agent was detected in acute- and convalescent-phase serum specimens from five of six ill residents as measured by enzyme immunoassay, but not for Norwalk agent as measured by radioimmunoassay. This report of an outbreak of Snow Mountain agent gastroenteritis in an extended-care facility documents that these difficult-to-identify 27-nm viruses can cause outbreaks in inpatient settings.

Graczyk T.K. et al. *Foodborne Infections Vectored by Molluscan Shellfish.* Curr Gastroenterol Rep. 2000; 2(4) : 305-309.p Abstract: Foodborne diseases cause approximately 76 million illnesses, 325,000 hospitalizations, and 5000 deaths each year in the United States. The authors present and analyze information derived from epidemiologic investigations and surveillance systems on foodborne infections caused by consumption of molluscan shellfish. This review focuses on the bias in reporting of shellfish-vectored illness, prevention and control of such infections, the origin of recognized viral and bacterial etiologic agents, and a new potential public

health threat of a food-and-waterborne protozoan contaminant, Cryptosporidium parvum.

Greenaway C. et al. *A foodborne outbreak causing a cholinergic syndrome.* J Emerg Med. 1996; 14(3) : 339-44.p Abstract: We report a foodborne outbreak causing a cholinergic syndrome in three members of a family. The clinical presentation was characterized by nausea, vomiting, abdominal pain, and weakness. Physical examination revealed evidence of peripheral motor weakness and decreased level of consciousness in all three patients. Bradycardia, hypotension, and seizures occurred in two patients. Although initial therapy included administration of antitoxin for possible botulism, subsequent investigation revealed evidence of accidental organophosphate (fensulfothion) poisoning. The ubiquitous use of organophosphates as agricultural and household insecticides has ensured their continuing importance as causes of foodborne poisoning in both developed and developing countries. Physicians must remain alert to the possibility of non-bacterial causes of foodborne outbreaks in order to initiate prompt and appropriate investigations and specific therapy.

Greiser-Wilke I. et al. *[Methods for the detection of viral contamination in food of animal origin].* DTW Dtsch Tierarztl Wochenschr. 1994; 101(7) : 284-90.p Abstract: Contamination of foods of animal origin with pathogenic human viruses may occur during handling or through polluted water. Most of these viruses are pathogens originating from the human gastrointestinal tract. They can be transmitted by the consumption of contaminated food and often cause disease. A survey is given of DNA- and RNA-viruses that may occur as contaminants of foods. In addition, the classical methods for detecting viral contaminations in foods are summarized. They are based on the effects after virus inoculation of cell cultures. Besides the fact that these methods are not economic and time consuming, they do not permit detection of some of the most important foodborne gastroenteritis viruses. The possibility of replacing these methods by detecting the viral genomes using hybridization and polymerase chain reaction (PCR) is discussed.

Griffiths M.W. *Applications of bioluminescence in the dairy industry.* J Dairy Sci. 1993; 76(10) : 3118-25.p Abstract: Several applications of ATP bioluminescence of relevance to the dairy industry have been proposed. This paper reviews some of the major benefits of the technology. New developments in bioluminescence research have made the simple, rapid, sensitive detection of foodborne pathogens a distinct possibility.

Griffiths M.W. *Rapid microbiological methods with hazard analysis critical control point.* J AOAC Int. 1997; 80(6) : 1143-50.p Abstract: The proactive approach to ensuring food safety termed hazard analysis critical control point (HACCP) was introduced in the 1960s by the Pillsbury Company, in collaboration with the U.S. Army Natick Laboratories and National Aeronautics and Space Administration, to help guarantee that astronauts would not be incapacitated by the trauma of foodborne illness during space flights. The approach has subsequently been adopted as the standard food safety management system world-wide and is seen as forming the basis for harmonization of food inspection regulations necessitated by trade agreements such as General Agreement on Tariffs and Trade and North American Free Trade Agreement as the move toward globalization of trade in food products gains momentum. The new U.S. Department of Agriculture Mega-Reg requires mandatory introduction of HACCP, and the Food Safety Enhancement Program of Agriculture and Agri-food Canada, as well as the "due diligence" legislation of the European Union, is centered on HACCP principles.

Groody E.P. *Detection of foodborne pathogens using DNA probes and a dipstick format.* Mol Biotechnol. 1996; 6(3) : 323-7.p Abstract: The detection of foodborne microorganisms has traditionally been done using microbiologically based methods. Such "gold standard" methods are generally reliable but have the disadvantages of being labor intensive, subjective, and time consuming. Over the last several years, the development of DNA probe-based methods has simplified the methods used to detect organisms such as Salmonella, Listeria, and E. coli by targeting the unique DNA or RNA sequences of these organisms using DNA probes and nonradioactive detection.

Gutierrez A. et al. *[Presence of Clostridium perfringens in meat-based preparations in public food services in central San Jose, Costa Rica].* Arch Latinoam Nutr. 1999; 49(3) : 275-8.p Abstract: In Costa Rica there are a large number of public food services distributed along the country, where a considerable number of people eat daily. Clostridium perfringens is a bacteria associated with foodborne illness related, especially, to meat products kept for long time at temperatures under 70 degrees C. The aim of this study was to evaluate the public food services that use water baths for keeping food hot in order to establish the presence of C. perfringens in cooked bovine meat dishes and to evaluate the enterotoxigenic capacity of the strains isolated. 81 samples of cooked bovine meat plates coming from 27 public food services, located in the Central County of San Jose were analyzed. The methodology described by Labbe & Harmon for the isolation of C. perfringens was used in 10 g of sample. Also, the enterotoxigenic capacity of the strains was evaluated using the passive-reverse-latex-agglutination assay from Oxoid. From the 27 public food services analyzed, eight (30%) were positive in the three samplings done, nine (33%) were positive in one or two occasions, and ten (37%) were negative all times. This implies that in 17 (63%) of the establishments studied, the bacteria was isolated at least once. From the 81 preparations studied, 37 (46%) were positive for the bacteria. The temperatures at which food was kept varied from 56 to 82 degrees C, with an average of 68.7 degrees C. From the 37 strains identified as C. perfringens, 12 (32%) were positive for enterotoxin. In conclusion, the

presence of C. perfringens in bovine meat dishes, maintained in water baths, represents an important risk for public health, and the temperature at which the preparation is kept is critical for the multiplication of the bacteria.

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Haapapuro E.R. et al. *Review--animal waste used as livestock feed: dangers to human health.* Prev Med. 1997; 26(5 Pt 1) : 599-602.p Abstract: Foodborne illness remains a common and serious problem, despite efforts to improve slaughterhouse inspection and food preparation practices. A potential contributor to this problem that has heretofore escaped serious public health scrutiny is the feeding of animal excrement to livestock, a common practice in some parts of the United States. In 1994, 18% of poultry producers in Arkansas collectively fed more than 1,000 tons of poultry litter to cattle, and the procedure is also common in some other geographic areas as a means of eliminating a portion of the 1.6 million tons of livestock wastes produced in the United States annually. While heat processing reliably kills bacterial pathogens, its use is limited by expense and other factors. Deep-stacking and ensiling are commonly used by farmers to process animal wastes, but the maximal temperatures achieved in stacked poultry litter are typically in the range of 43 to 60 degrees C (110 to 140 degrees F), below the inactivation temperatures of pathogenic salmonella and Escherichia coli species, and far below the USDA's recommended cooking temperatures of 71 to 77 degrees C (160 to 170 degrees F) for potentially manure-tainted meat products. In addition to the spread of potential pathogens, using animal wastes as feed presents the possibility that antibiotic-resistant bacteria may spread from one animal to another and that antibiotics or other chemicals may be passed between animals. Few research reports have addressed the safety of this practice, and those studies that have been published have generally been in controlled and artificial environments, rather than in on-farm conditions. Further microbiological studies are recommended to assess the extent of risk.

Hall R.L. *Foodborne illness: implications for the future.* Emerg Infect Dis. 1997; 3(4) : 555-9.p Abstract: Many outbreaks of foodborne illness, even those involving newly recognized pathogens, could have been avoided if certain precautions had been taken. This article will draw on existing information to suggest realistic measures that, if implemented, are most likely to avert or diminish the impact of new foodborne disease outbreaks.

Hanes D.E. et al. *DNA probe for detecting Salmonella enteritidis in food.* Mol Cell Probes. 1995; 9(1) : 9-18.p Abstract: Salmonellosis is the most frequently reported foodborne illness in the United States, with Salmonella enteritidis being the leading cause of these outbreaks. Nucleotide sequence comparisons of the Salmonella plasmid virulence (spv) genes of S. enteritidis with those of S. typhimurium and S. dublin have revealed that a single base-pair change unique to S. enteritidis is present in the spvA gene. An 18-base synthetic oligonucleotide probe (SE-probe) that is completely homologous to the spvA gene of S. enteritidis but which has one base pair mismatch with other salmonellae was shown to be specific for S. enteritidis. In colony hybridization blots, 129 isolates of S. enteritidis, 29 other species of Salmonella, and 17 non-Salmonella spp. were tested with the SE-probe. The SE-probe hybridized with 96% of the S. enteritidis strains tested but did not react with the other Salmonella or non-Salmonella strains. These data suggest that the SE-probe can be used in a specific and rapid detection assay for S. enteritidis.

Hao Y.Y. et al. *Inhibition of Listeria monocytogenes and Aeromonas hydrophila by plant extracts in refrigerated cooked beef.* J Food Prot. 1998; 61(3) : 307-12.p Abstract: Refrigerated ready-to-eat foods are becoming increasingly popular but are often vulnerable to contamination and subsequent growth by psychrotrophic foodborne pathogens. Consequently, there is a need for additional methods to assure the safety of these foods. Beef slices prepared from roasted whole sirloin tips were used in the study. Nine plant extracts were evaluated for ability to inhibit the growth of two psychrotrophic pathogens (Aeromonas hydrophila and Listeria monocytogenes) in refrigerated cooked beef. Results indicated that only eugenol (clove extract) and pimento extract significantly inhibited the growth of A. hydrophila and L. monocytogenes. However, L. monocytogenes was not as sensitive as was A. hydrophila to both treatments, especially to pimento extracts. These results suggest that plant extracts might be useful as an antimicrobial in cooked ready-to-eat meat.

Hartung M. *[Occurrence of enteritis-causing salmonellae in food and in domestic animals in 1991].* DTW Dtsch Tierarztl Wochenschr. 1993; 100(7) : 259-61.p Abstract: The control of salmonellae in foods and animals in Germany, 1991, is based on voluntary contributions of veterinary institutions, e. g. governmental investigation centres, universities, agricultural institutions and slaughter-house laboratories. The results of questionnaire-based evaluations are presented (s. a. HARTUNG, 1993 a). Also reported were 101 outbreaks involving 2272 cases of salmonellosis (fig. 1), of which 92% were caused by S. enteritidis. 46% of the cases were caused by egg and egg-containing meals, 24% by bakery products, often containing raw eggs. From poultry meat the organism was only isolated in less than 1% of the known cases. Meat and meat products (10%) and milk (5%) were further sources of infection. Summarizing it can be assumed that in 70% of the cases the cause of foodborne salmonellosis were meals prepared with raw eggs. The mean salmonella rate in routine food investigations was 0.88% (tab. 1). Poultry had a salmonella rate of 13% and eggs, incl. egg-containing dishes, a rate of 1%. All other food groups were contaminated with salmonella at the level of the mean rate (meat and meat products) or less (fish and milk and their products: 0.1%). The mean salmonella rate in diagnostic examinations of domestic animals was 5.77% (tab. 2).

Cattle and chicken showed salmonella rates at the level of the mean rate, whereas pig, sheep, goats and equines showed much lower levels. On the other hand "other poultry" (9.5%) and especially chicks (13%) had higher levels of salmonella.(ABSTRACT TRUNCATED AT 250 WORDS).

Hartung M. et al. *Yersinia in effluents from the food-processing industry.* Rev Sci Tech. 1991; 10(3) : 799-811.p Abstract: Yersinia enterocolitica and Yersinia pseudotuberculosis are current sources of pathogenic strains in humans and animals. Yersiniae infections occur throughout the world, but are most prevalent in regions with moderate and subtropical climates. In Australia, Central Europe and North America, cases of human infections with Yersinia enterocolitica now rank in third place. The food-processing industry may influence the epidemiological situation in different ways. Effluents which contaminate the environment may originate from slaughterhouses; e.g. from sewage contaminated with faeces from the lairage or contaminated effluents from the actual slaughter areas. The carcasses may serve as carriers of the organisms to the food-processing plants where they eventually contaminate the processed foods. Rodents and pests may also be carriers. Pathogenic Y. enterocolitica and Y. pseudotuberculosis strains mainly occur in swine and pork. The ability to multiply under refrigeration and in vacuum-packaged products means that pathogenic Y. enterocolitica can cause foodborne diseases. If a plant harbours any pathogenic Yersiniae, transfer of the contaminant to the sewage is possible. Although pathogenic Yersiniae from infected animals can survive in sewage and in surface waters, the role of properly treated sewage in the transmission of yersiniosis seems to be of minor importance. If the recommendations for modern slaughter techniques are properly followed, the spread of pathogens in the slaughterhouses and, subsequently, into other food-processing plants can be minimised.

Hastings L. et al. *Salm-Net facilitates collaborative investigation of an outbreak of Salmonella tosamanga infection in Europe.* Commun Dis Rep CDR Rev. 1996; 6(7) : R100-2.p Abstract: Twenty-eight cases of Salmonella tosamanga infection were identified in six western European countries during the first half of 1995. Salm-Net, a European system for collaborative surveillance of gastrointestinal infection, detected the outbreak and coordinated its investigation. There were 28 cases, 14 of each sex, with a broad age distribution. Interviews with cases to identify common food and other exposures failed to generate a working hypothesis. The initial cluster occurred in a period of eight weeks and, since only one further case occurred in June, the investigation was closed. This incident shows that Salm-Net is effective in identifying international outbreaks of human salmonellosis. Practical difficulties in the field investigation of the outbreak are discussed.

Hatheway C.L. *Botulism: the present status of the disease.* Curr Top Microbiol Immunol. 1995; 195 : 55-75.p Abstract: The main form of human botulism throughout the world is the classic foodborne intoxication. Would botulism is very rare, and most of the documented cases have been found in the United States. While infant botulism remains rare throughout the world, it has become the most frequent form of the disease in the United States in recent years. On very rare occasions botulism results from growth and toxin production in humans other than infants. Botulism occurs in animals with much higher frequency. The causative organisms constitute a diverse group of clostridia, resulting in nomenclature problems. Human botulism is largely limited to toxin types A, B, and E, while type C botulism predominates in avian and nonhuman mammalian species. The diagnosis of botulism is made on the basis of the neurologic signs and symptoms that it causes in humans and animals. The diagnosis is confirmed by tests that identify the toxin and toxigenic organisms in patient and food specimens. Treatment includes supportive intensive care and use of therapeutic antitoxin.

Hayes P.S. et al. *Isolation and characterization of a beta-D-glucuronidase-producing strain of Escherichia coli serotype O157:H7 in the United States.* J Clin Microbiol. 1995; 33(12) : 3347-8.p Abstract: A phenotypic variant of Escherichia coli serotype O157:H7 (G5101) was isolated from a patient with bloody diarrhea. Strain G5101 does not ferment sorbitol but is beta-D-glucuronidase and urease positive. Serotyping and colony hybridization using a serotype-specific DNA probe confirmed that the isolate was O157:H7. G5101 produces Shiga-like toxins I and II and contains an eae gene that is highly conserved in the O157:H7 serotype. This strain would have been missed by laboratories that screen for the sorbitol-negative, beta-D-glucuronidase-negative phenotype in isolating E. coli O157:H7 from clinical and food specimens.

Headrick M.L. et al. *The epidemiology of raw milk-associated foodborne disease outbreaks reported in the United States, 1973 through 1992.* Am J Public Health. 1998; 88(8) : 1219-21.p Abstract: OBJECTIVES: This study describes the epidemiology of raw milk-associated outbreaks reported to the Centers for Disease Control and Prevention from 1973 through 1992. METHODS: Surveillance data for each reported raw milk-associated outbreak were reviewed. A national survey was conducted to determine the legal status of intrastate raw milk sales for the period 1973 through 1995. RESULTS: Forty-six raw milk-associated outbreaks were reported during the study period; 40 outbreaks (87%) occurred in states where the intrastate sale of raw milk was legal. CONCLUSIONS: Consumption of raw milk remains a preventable cause of foodborne disease outbreaks.

Hedberg C.W. et al. *A multistate outbreak of Salmonella javiana and Salmonella oranienburg infections due to consumption of contaminated cheese.* JAMA. 1992; 268(22) : 3203-7.p Abstract: OBJECTIVE--To determine

the source of an outbreak of Salmonella javiana and Salmonella oranienburg infections. DESIGN--Laboratory-based statewide surveillance for Salmonella infections and two separate case-control studies. SETTING--Community- and industry-based studies conducted from May through October 1989. PARTICIPANTS--Thirty-one culture-confirmed outbreak-associated cases of S javiana infection and 60 community controls matched for telephone prefix, gender, and age in case-control study I; 50 cases, 100 community controls, and 64 family member controls in case-control study II. RESULTS--One hundred thirty-six culture-confirmed cases of S javiana infection and 11 cases of S oranienburg infection were associated with the outbreak in Minnesota. Outbreak-associated cases were also identified in Wisconsin (15 cases), and in Michigan and New York (one case each). Cases were more likely than controls to have consumed mozzarella cheese manufactured at a single cheese plant (plant X) or cheese that had been shredded at processing plants that also shredded cheese manufactured at plant X (odds ratio [OR], 7.2; 95% confidence interval [CI], 1.7 to 23.2; P < .01). The outbreak-associated strains of both serovars were isolated from two unopened 16-oz (0.45-kg) blocks of mozzarella cheese produced at plant X. The most probable numbers of Salmonella organisms in these samples were 0.36/100 g and 4.3/100 g. CONCLUSIONS--The potential for bacterial pathogen contamination of cheese during manufacture and processing has important epidemiologic implications, particularly because cheese consumption has recently increased in the United States. Low-level contamination of a nationally distributed food product can cause geographically dispersed foodborne outbreaks that may be difficult to detect.

Hedberg C.W. et al. *An international foodborne outbreak of shigellosis associated with a commercial airline.* JAMA. 1992; 268(22) : 3208-12.p Abstract: OBJECTIVE--To determine the source of an international outbreak of shigellosis associated with consumption of food served by a Minnesota-based airline. DESIGN--Cohort studies of players and staff of a Minnesota-based professional football team and passengers on flights with a confirmed case of outbreak-associated Shigella sonnei infection. SETTING--Community- and industry-based studies conducted from October through November 1988. PARTICIPANTS--Sixty-five football team players and staff, and 725 airline passengers in the cohort studies. RESULTS--Twenty-one (32%) of 65 football players and staff developed shigellosis that was associated with consumption of cold sandwiches prepared at the airline flight kitchen (relative risk [RR], 17.1; 95% confidence interval [Cl], 2.4 to 120; P < .001). Confirmed or probable shigellosis was identified among 240 passengers on 219 flights to 24 states, the District of Columbia, and four countries between September 14 and October 13. An outbreak-associated strain of S sonnei was isolated from football players and staff, airline passengers, and flight attendants. Thirty (4.1%) of 725 passengers on 13 flights with confirmed cases had confirmed or probable shigellosis. Illness was associated with consumption of cold food items served on the flights and prepared by hand at the airline flight kitchen (RR, 5.7; 95% Cl, 1.4 to 23.5; P < .01). CONCLUSIONS--This international outbreak of shigellosis was identified only because of the occurrence of an index outbreak involving a professional football team. Prevention of Shigella transmission in mass catering establishments may require reduction of hand contact in the preparation of cold food items or elimination of these items from menus.

Hedberg C.W. et al. *Food safety for the 1990s.* Minn Med. 1993; 76(6) : 33-6.p Abstract : The epidemiology of foodborne disease has evolved as a result of changes in the types and sources of food consumed, new methods of food production, the emergence of new infectious agents, and new trends involving known infectious agents. The results of foodborne disease surveillance at the Minnesota Department of Health demonstrate the importance of these factors and suggest that foodborne disease problems are actually much more widespread than previously acknowledged. The public health agenda for the 1990s must include a comprehensive review of food safety.

Hedberg C.W. et al. *An outbreak of foodborne illness caused by Escherichia coli O39:NM, an agent not fitting into the existing scheme for classifying diarrheogenic E. coli.* J Infect Dis. 1997; 176(6) : 1625-8.p Abstract: An outbreak of gastrointestinal illness with clinical and epidemiologic features of enterotoxigenic Escherichia coli (ETEC) occurred among patrons of a restaurant during April 1991. Illnesses among several groups of patrons were characterized by diarrhea (100%) and cramps (79%-88%) lasting a median of 3-5 days. Median incubation periods ranged from 50 to 56 h. A nonmotile strain of E. coli (E. coli O39), which was negative for heat-labile (LT) and heat-stable (STa, STb) ETEC toxins, was isolated only from ill patrons. This organism produced enteroaggregative E. coli heat-stable enterotoxin 1 and contained the enteropathogenic E. coli gene locus for enterocyte effacement; it did not display mannose-resistant adherence, but produced attaching and effacing lesions in the absence of mannose on cultured HEp-2 cells. E. coli that are not part of highly characterized but narrowly defined groups may be important causes of foodborne illness.

Hedlund K.O. et al. *Epidemiology of calicivirus infections in Sweden, 1994-1998.* J Infect Dis. 2000; 181 Suppl 2 : S275-80.p Abstract: Outbreaks of acute gastroenteritis are frequently caused by caliciviruses. Electron microscopy was used to search for these viruses in fecal samples from patients with acute gastroenteritis. Of 5800 samples collected and analyzed from November 1994 to June 1998, 3700 were associated with outbreaks. A total of 676 outbreaks were analyzed, and viruses were found in 67%. Caliciviruses, usually Norwalk-like viruses (NLVs), were found in 407 (89%) of 455 outbreaks, while Sapporo-like viruses were identified in nine outbreaks, including six that were suspected to include foodborne transmission. Sixty percent of the 1041 patients with calicivirus infections were between 70 and 90 years of age. Food- and waterborne infections were associated with 66 calicivirus outbreaks.

Virus-positive outbreaks were documented mainly during winter and spring. The longitudinal survey showed that caliciviruses, and especially the NLVs, cause most nosocomial and community-associated outbreaks in Sweden.

Heinitz M.L. et al. *Incidence of Salmonella in fish and seafood.* J Food Prot. 2000; 63(5) : 579-92.p Abstract: Field laboratories of the U.S. Food and Drug Administration collected and tested 11,312 import and 768 domestic seafood samples over a 9-year period (1990 to 1998) for the presence of Salmonella. The overall incidence of Salmonella was 7.2% for import and 1.3% for domestic seafood. Nearly 10% of import and 2.8% of domestic raw seafood were positive for Salmonella. The overall incidence of Salmonella in ready-to-eat seafood and shellfish eaten raw was 0.47% for domestic--one shucked oyster and one shark cartilage powder. The incidence in the 2,734 ready-to-eat import seafood was 2.6%--cooked shrimp, shellfish or fish paste, smoked fish, salted/dried fish, and caviar. The incidence in import shellfish consumed raw was 1% in oyster, 3.4% in clams, and 0% in mussels. The incidence in raw, import fish was 12.2%. Distribution of Salmonella in seafood on a regional basis indicated the incidence to be highest in central Pacific and Africa and lowest in Europe/Russia and North America (12% versus 1.6%). Data on a country basis indicated Vietnam to have the highest (30%) and Republic of Korea the lowest (0.7%). While the most frequent serotypes in import seafood were Salmonella Weltevreden (1st), Salmonella Senftenberg (2nd), Salmonella Lexington, and Salmonella Paratyphi-B (3rd, equal numbers for each serotype), the top 20 list included Salmonella enteritidis (5th), Salmonella Newport (6th), Salmonella Thompson (7th), Salmonella typhimurium (12th), and Salmonella anatum (13th), commonly involved in foodborne illness in the United States. Because the incidence in the present study is based on only a small fraction of the seafood imported into the United States, efforts should be directed toward implementation of hazard analysis and critical control points to reduce the incidence of Salmonella in seafood without relying on testing for Salmonella.

Henzler D.J. et al. *Management and environmental risk factors for Salmonella enteritidis contamination of eggs.* Am J Vet Res. 1998; 59(7) : 824-9.p Abstract: OBJECTIVE: To analyze data for 60 poultry flocks voluntarily enrolled in the Pennsylvania Salmonella enteritidis Pilot Project and determine management and environmental risk factors associated with production of S enteritidis-contaminated eggs. SAMPLE POPULATION: 60 flocks for which at least 1 environmental sample (manure or egg-handling equipment) was positive for S enteritidis. PROCEDURE: Samples of manure, egg-handling equipment, and mice were submitted for bacterial culture of S enteritidis. When S enteritidis was isolated from environmental samples, 1,000 eggs were collected from the flock every 2 weeks for 8 weeks and submitted for bacterial culture. RESULTS: 18 flocks were found to have produced contaminated eggs. Estimated overall prevalence of contaminated eggs was 2.64/10,000 eggs produced, but flock-specific prevalence ranged from 0 to 62.5/10,000 eggs. Flocks with high levels of manure contamination were 10 times as likely to produce contaminated eggs as were flocks with low levels. However, 5 flocks with low levels of manure contamination produced contaminated eggs. CONCLUSIONS: Evaluation of the level of manure contamination could be used to help identify flocks at risk of producing S enteritidis-contaminated eggs. CLINICAL RELEVANCE: Flocks with high levels of S enteritidis-contaminated manure appeared to pose the greatest public health threat, and on-farm programs to reduce the prevalence of egg contamination should be developed for farms with high levels of manure contamination. Efforts to reduce the overall number of on-farm pathogens should decrease the incidence of foodborne disease in humans.

Hernandez P.E. et al. *[Utilization of lactic bacteria in the control of pathogenic microorganisms in food].* Microbiologia. 1993; 9 Spec No : 37-48.p Abstract: The lactic acid bacteria have the potential to inhibit the growth of pathogenic and spoilage bacteria and the possibility exists of using them to improve the hygienic quality and to extend the shelf-life of different foods. Among the many inhibitory substances produced by the lactic acid bacteria, the bacteriocins are of particular interest. It has been the objective of this work to review the bacteriocins produced by lactic acid bacteria from the genera Lactococcus, Lactobacillus and Pediococcus, as well as Leuconostoc and Carnobacterium to understand their relevant biochemical, immunological and genetic characteristics. The lactic acid bacteria may also express foreign genes codifying metabolites with antimicrobial activities against foodborne pathogens of interest, and this will also permit hypothesize about theoretical and experimental models of microbial antagonism mediated by the lactic acid bacteria.

Herwaldt B.L. et al. *An outbreak in 1996 of cyclosporiasis associated with imported raspberries. The Cyclospora Working Group.* N Engl J Med. 1997; 336(22) : 1548-56.p Abstract: BACKGROUND: Cyclospora cayetanensis is a parasite that causes gastroenteritis. Until last year most of the documented cases of cyclosporiasis in North America were in overseas travelers. In 1996, a large outbreak of cyclosporiasis occurred in North America. We investigated this outbreak. METHODS: Health departments solicited information from clinicians and laboratories on cases of cyclosporiasis, which were then reported to the Centers for Disease Control and Prevention and to Health Canada. We conducted retrospective cohort studies for the cases associated with events (e.g., luncheons) and attempted to identify the sources of the implicated food. RESULTS: A total of 1465 cases of cyclosporiasis were reported by 20 states, the District of Columbia, and 2 provinces. Of these cases, 978 (66.8 percent) were laboratory confirmed and 725 (49.5 percent) were associated with 55 events that were held from May 3 through June 14. Raspberries were definitely served at 50 events and may have been served at 4 events. For 27 of the 41 events for which adequate data were available (65.8 percent), the associations between the

consumption of berries (raspberries with or without other berries) and cyclosporiasis were statistically significant (P<0.05). For all 29 events for which there were good data, the raspberries definitely came from Guatemala (21 events, 72.4 percent) or may have come from Guatemala (8 events, 27.6 percent). As few as five Guatemalan farms could have accounted for the 25 events for which the raspberries could be traced to a single exporter per event. The mode of contamination of the raspberries remains unclear. CONCLUSIONS: This large outbreak of cyclosporiasis in North America in 1996 was associated with the consumption of Guatemalan raspberries. The outbreak illustrates the need to consider that a local cluster of foodborne illness may be part of a widespread outbreak and to pursue investigations to the source of the implicated vehicle.

Hill W.E. *The polymerase chain reaction: applications for the detection of foodborne pathogens.* Crit Rev Food Sci Nutr. 1996; 36(1-2) : 123-73.p Abstract: Faster methods for the detection of foodborne microbial pathogens are needed. The polymerase chain reaction (PCR) can amplify specific segments of DNA and is used to detect and identify bacterial genes responsible for causing diseases in humans. The major features and requirements for the PCR are described along with a number of important variations. A considerable number of PCR-based assays have been developed, but they have been applied most often to clinical and environmental samples and more rarely for the detection of foodborne microorganisms. Much of the difficulty in implementing PCR for the analysis of food samples lies in the problems encountered during the preparation of template DNAs from food matrices; a variety of approaches and considerations are examined. PCR methods developed for the detection and identification of particular bacteria, viruses, and parasites found in foods are described and discussed, and the major features of these reactions are summarized.

Hill W.E. et al. *Identification of foodborne pathogens by nucleic acid hybridization.* Int J Food Microbiol. 1991; 12(1) : 67-75.p Abstract: Nucleic acid hybridization methods have been developed and used to identify microorganisms in foods. Tests performed on mixed cultures save the time required to establish pure cultures. Enterotoxigenic or invasive strains of foodborne bacterial pathogens are detected with probes that identify genes responsible for virulence. Hybridization tests signal the presence or absence of a particular strain or an entire genus and are especially well suited for screening foods for specific pathogens. With the colony hybridization assay format, foodborne bacteria harboring a specific gene can be enumerated. However, hybridization tests require the presence of 10(5) to 10(6) cells to yield a positive result, thereby limiting sensitivity and necessitating a time-consuming growth step. In vitro DNA amplification techniques increase the amount of DNA segments 10(5)-10(6)-fold in 2 to 3 h, thus enhancing test sensitivity.

Hinton A. Jr et al. *Physical, chemical, and microbiological changes in the ceca of broiler chickens subjected to incremental feed withdrawal.* Poult Sci. 2000; 79(4) : 483-8.p Abstract: Trials were conducted to determine the effect of feed withdrawal on the weight, pH, native bacterial flora, and the persistence of Salmonella typhimurium in the ceca of market-age broilers. Broilers were provided medicated or unmedicated feed and then were subjected to feed withdrawal for 0 to 24 h in transportation crates or on litter. After feed withdrawal, broilers were stunned, bled, scalded, and picked. One cecum from each bird was aseptically removed and weighed. The cecum was then blended in 20 mL of distilled water, and the pH of the blended suspension was measured. The number of total aerobes, Enterobacteriaceae, S. typhimurium, and lactic acid bacteria in the suspension were enumerated on the appropriate bacteriological media. Results indicated that up to 24 h of feed withdrawal produced no significant change in cecal weight and that cecal pH varied by up to 0.3 units during feed withdrawal. There were significant increases in the population of Enterobacteriaceae during feed withdrawal in Trials 2 and 3, and there was a significant increase in the population of cecal aerobes in Trial 3. Feed withdrawal produced significant decreases in the population of lactic acid bacteria in all trials, but no significant change in the population of S. typhimurium occurred during feed withdrawal. There were no significant differences in cecal weight, pH, native bacteria populations, or S. typhimurium populations between broilers that were subjected to feed withdrawal on litter or in crates. Findings indicate that feed withdrawal does not always effectively evacuate the contents of the ceca and that the ceca of broilers subjected to feed withdrawal can remain a source of foodborne bacterial pathogens.

Hitchins A.D. *Assessment of alimentary exposure to Listeria monocytogenes.* Int J Food Microbiol. 1996; 30(1-2) : 71-85.p Abstract: Survey data on the frequency of foodborne occurrence and dietary exposure to Listeria monocytogenes were used to estimate the mininmal mean per person annual rate of exposure in the United States during the late 1980s. The estimate was restricted to ready-to-eat (RTE) foods because proper cooking was assumed to be listericidal. The mean amount of each food type per L. monocytogenes occurrence was calculated in about 100 sources, and dietary intake data were used to calculate the mean number of occurrences of L. monocytogenes consumption per person per year. The mean number of occurrences consumed annually per person was determined to be 10 to 100 for RTE food values of 2 to 20% of the total dietary intake, respectively. The frequency of foodborne listeriosis (approximately 10(-5)) was consistent with the estimated exposure rate only if the susceptible population was unexpectedly small or extremely high doses were necessary for infection. Because little evidence is available to support a high rate of unreported non-severe infections, this study was concerned only with severe listeriosis cases. Published frequencies of L. monocytogenes concentrations in food were used to convert occurrences to colony forming units (CFU). Low L. monocytogenes concentrations

(approximately 1 CFU/g) were too frequent to be responsible for listeriosis in susceptible subjects, would have caused listeriosis only with extremely low probability in a one-cell threshold infection model. The probability of exposure to a higher dose (> or = 10(3) CFU) was large enough to account for the observed rate of listeriosis.

Hitchins A.D. et al. *Feasibility of a defined microflora challenge method for evaluating the efficacy of foodborne Listeria monocytogenes selective enrichments.* J Food Prot. 2000; 63(8) : 1064-70.p Abstract: Comparison of isolation methods for microbial pathogens is complicated by the variable interference caused by the competitive microflora present in test samples such as foods. In principle, using measured amounts of a standard competitor in a defined surrogate food matrix might control the effect of variable interference. This possibility was investigated using Listeria monocytogenes and enrichment broths belonging to the acriflavine-nalidixate selective agent class. Triplicate test sample sets were prepared. Each set consisted of suspensions of variable levels of the standard competitor, Enterococcus faecium strain 111 (approximately 10 to 10(9) CFU/25 g), mixed with a low constant level (10 to 100 CFU/25 g) of L. monocytogenes. These test samples were enriched at 30 degrees C for 48 h in different selective media and streaked onto selective isolation agars. The input CFU ratio (E. faecium/L. monocytogenes) that permitted a 50% end point L. monocytogenes recovery was 2.2 x 10(6) or higher for the Food and Drug Administration one-step enrichments and 0.8 x 10(6) for the International Standards Organization (ISO) two-step enrichment. These and other results show that this evaluation method is feasible with this class of enrichments. Interestingly, L. monocytogenes could be detected in enrichment cultures at high-input E. faecium/L. monocytogenes ratios even when the enriched samples were plated onto nonselective media. The pinpoint colonies of L. monocytogenes embedded in a confluent lawn of E. faecium 111 were detectable by their contrasting coloration in Henry obliquely transmitted illumination.

Hlady W.G. et al. *Vibrio vulnificus from raw oysters. Leading cause of reported deaths from foodborne illness in Florida.* J Fla Med Assoc. 1993; 80(8) : 536-8.p Abstract: Seventy-two cases of Vibrio vulnificus infection from raw oysters were reported from 1981-1992; 36 (50%) patients died, making this infection the leading cause of reported deaths from foodborne illness in Florida. The bacterium naturally occurs in coastal waters and may contaminate legally harvested and properly handled shellfish. Infection, usually by ingestion of contaminated raw oysters, can cause severe illness especially in individuals with preexisting liver disease. They are at 80 times greater risk of illness and over 200 times greater risk of death. The case fatality rate (63%) among patients with liver diseases was over 2.5 times the rate (23%) among those without liver disease. Infections usually occurred during the warm weather months and presented as fulminant septicemia, often complicated by necrotizing cutaneous lesions. Early treatment with antibiotics, debridement and amputation when necessary may improve survival. Prevention relies upon educating patients regarding risk and thorough cooking of shellfish.

Hoffmann B. et al. *Characterization of plasmid regions of foodborne Yersinia enterocolitica biogroup 1A strains hybridizing to the Yersinia enterocolitica virulence plasmid.* Syst Appl Microbiol. 1998; 21(2) : 201-11.p Abstract: The aim of our study was to find out if plasmids of foodborne Yersinia enterocolitica biogroup 1A strains harbour genes related to the virulence genes located on the virulence plasmid pYV of Yersinia enterocolitica. The foodborne strains were isolated from pork, as pigs are considered as an important reservoir for enteropathogenic Y. enterocolitica 0:3 and 0:9 strains. The plasmids of the foodborne strains were characterized by restriction enzyme analysis and hybridized to the virulence plasmid pYV of pathogenic Y. enterocolitica strains (0:3 biogroup 4; 0:9 biogroup 2). In several cases the plasmids of the foodborne strains showed homologies to parts of the pYV plasmid. Analysis of the hybridizing regions revealed that genes involved in replication, sequences of transposable elements and an endonuclease gene caused the observed hybridization to the virulence plasmid. In cause of the study also a remnant of a Tn3-like transposon was shown to be present adjacent to the yadA gene on the pYV plasmid. Although there is evidence that at least some strains of Y. enterocolitica biogroup 1A might possess pathogenic properties none of the well known plasmid encoded virulence genes were present on the plasmids of the investigated foodborne biogroup 1A strains.

Hood S.K. et al. *Adherence to stainless steel by foodborne microorganisms during growth in model food systems.* Int J Food Microbiol. 1997; 37(2-3) : 145-53.p Abstract: Biofilm formation on stainless steel by Salmonella typhimurium, Listeria monocytogenes, Escherichia coli O157:H7, Pseudomonas fragi and Pseudomonas fluorescens during growth in model food systems was studied. Test growth media included tryptic soy broth (TSB), diluted TSB (dTSB), 1% reconstituted skim milk (RSM) and diluted meat juice (DMJ). Adherent cells were stained with acridine orange and enumerated using epifluorescent microscopy and computerized image analysis. Cells were observed on the stainless steel surface after 1 h in all of the media. However, the increases in the number of adherent cells over time was seen only with S. typhimurium in DMJ, E. coli O157:H7 in TSB, dTSB and DMJ, P. fragi in RSM and P. fluorescens in RSM. The medium which produced the highest observed level of adherent cells was different for each microorganism.

Hu Y. et al. *Rapid and sensitive detection of Escherichia coli O157:H7 in bovine faeces by a multiplex PCR.* J Appl Microbiol. 1999; 87(6) : 867-76.p Abstract: Cattle are considered the major reservoir for Escherichia coli O157:H7, one of the newly emerged foodborne human pathogens of animal origin and a leading cause of haemorrhagic colitis in humans. A sensitive test that can

accurately and rapidly detect the organism in the food animal production environment is critically needed to monitor the emergence, transmission, and colonization of this pathogen in the animal reservoir. In this study, a novel multiplex polymerase chain reaction (PCR) assay was developed by using 5 sets of primers that specifically amplify segments of the eaeA, slt-I, slt-II, fliC, rfbE genes, which allowed simultaneous identification of serotype O157:H7 and its virulence factors in a single reaction. Analysis of 82 E. coli strains (49 O157:H7 and 33 non-O157:H7) demonstrated that this PCR system successfully distinguished serotype O157:H7 from other serotypes of E. coli and provided accurate profiling of the shiga-like toxins and the intimin adhesin in individual strains. This multiplex PCR assay did not cross-react with the background bacterial flora in bovine faeces and could detect a single O157:H7 organism per gram of faeces when combined with an enrichment step. Together, these results indicate that the multiplex PCR assay can be used for specific identification and profiling of E. coli O157:H7 isolates, and may be applied to rapid and sensitive detection of E. coli O157:H7 in bovine faeces when combined with an enrichment step.

Hubert B. et al. *[Case control studies in investigation of food-borne infection outbreaks. Study of their utilization in France]*. Rev Epidemiol Sante Publique. 1992; 40(3) : 156-63.p Abstract: Among the 251 foodborne outbreaks investigated by public health officers in France in 1989, 62 (25%) used a case-control study to identify the responsible food. This survey aims to analyse the results of these 62 investigations. Thirty eight (61%) investigations found the responsible food(s); 10 investigations (16%) lacked power because of the small size of the population studied, but allowed to suspect the food with the highest odds ratio; 13 investigations (21%) gave results inconsistent with bacteriological studies or with hypothesis generated by the descriptive study: in 5 of it, food origin is questionable and in 8 investigations, methodological errors are likely. We could not conclude for one study. Among the surveys with case-control studies, 74% identified the food responsible with bacteriological or epidemiological confirmation, as opposed to 17% of other surveys which had only bacteriological confirmation. This study allowed us to give recommendations on the management of investigation and the interpretation of results to improve the efficiency of this practice.

Hutin Y.J. et al. *A multistate, foodborne outbreak of hepatitis A. National Hepatitis A Investigation Team.* N Engl J Med. 1999; 340(8) : 595-602.p Abstract: BACKGROUND: We investigated a large, foodborne outbreak of hepatitis A that occurred in February and March 1997 in Michigan and then extended the investigation to determine whether it was related to sporadic cases reported in other states among persons who had consumed frozen strawberries, the food suspected of causing the outbreak. METHODS: The cases of hepatitis A were serologically confirmed. Epidemiologic studies were conducted in the two states with sufficient numbers of cases, Michigan and Maine. Hepatitis A virus RNA detected in clinical specimens was sequenced to determine the relatedness of the virus from outbreak-related cases and other cases. RESULTS: A total of 213 cases of hepatitis A were reported from 23 schools in Michigan and 29 cases from 13 schools in Maine, with the median rate of attack ranging from 0.2 to 14 percent. Hepatitis A was associated with the consumption of frozen strawberries in a case-control study (odds ratio for the disease, 8.3; 95 percent confidence interval, 2.1 to 33) and a cohort study (relative risk of infection, 7.5; 95 percent confidence interval, 1.1 to 53) in Michigan and in a case-control study in Maine (odds ratio for infection, 3.4; 95 percent confidence interval, 1.0 to 14). The genetic sequences of viruses from 126 patients in Michigan and Maine were identical to one another and to those from 5 patients in Wisconsin and 7 patients in Arizona, all of whom attended schools where frozen strawberries from the same processor had been served, and to those in 2 patients from Louisiana, both of whom had consumed commercially prepared products containing frozen strawberries from the same processor. CONCLUSIONS: We describe a large outbreak of hepatitis A in Michigan that was associated with the consumption of frozen strawberries. We found apparently sporadic cases in other states that could be linked to the same source by viral genetic analysis.

Hwang K.L. et al. *An outbreak of Salmonella infection after a Chinese year-end party in central Taiwan.* J Microbiol Immunol Infect. 2000; 33(1) : 39-44.p Abstract: An outbreak of food poisoning caused by Salmonella O7 serogroup C1 and O8 serogroup C2, occurred in Taichung City after a Chinese year-end buffet party with 127 attendees including employees, relatives and guests of the Psychiatry Department of Changhua Christian Hospital (CCH). Among the 114 attendees interviewed, 96 (84.2%) reported developing symptoms within 120 h after the dinner on February 4, 1999. The time of onset ranged from 2 h to 101 h after the dinner with an average of 20 +/- 16 h. The median and mode incubation periods were 17 h and 16 h, respectively. Salmonella C1 and C2 serogroups were isolated from the stool samples of 45 attendees. Based on the results of interview questionnaire, the most likely contaminated food was eel kabayaki (OR = 4.8, 95% CI:1.6-14.9, $p < 0.01$) followed by baked mussels (OR = 4.04, 95% CI:1.3-12.1, $p = 0.01$). However, this result could not be confirmed by food sample investigation due to the lack of leftover food. Possible techniques for the prevention of food-borne disease transmission, enhancement of communication about foodborne disease outbreaks within the health reporting system, and the reduction of response time during an outbreak of infection are required.

Hyman F.N. et al. *Food and Drug Administration surveillance of the role of foreign objects in foodborne injuries.* Public Health Rep. 1993; 108(1) : 54-9.p Abstract: As part of its effort to assure a safe food supply, the Food and Drug Administration maintains a passive surveillance system for the reporting and followup of complaints related to food items. This surveillance system, called the Complaint Reporting System, records and investigates consumer

complaints about the quality of a specific food item, its packaging, or unexpected effects following consumption of the food. This study, relying on data gathered from the 2,726 reports of discovery of a foreign object in a food item during fiscal year 1989, develops a profile of consumer complaints, focusing on those associated with resultant injury or illness. Fourteen percent of all reported cases of foreign object exposure cited resultant illness or injury. The most common foreign object reported in food is glass, and the most common injury is a laceration or abrasion of soft tissues of the perioral area, including the throat. There was a disproportionate representation of children younger than age 3 years with documented illness or injury. Only 3 percent of the complaints came from attending health professionals; 82 percent were self-reported. Practitioner awareness of the system is limited primarily because literature in this area is scant. The collection and investigation of reports of foreign objects in food are important because such reports provide early warnings of potential problems with manufacturers' food items. Although data suggest that severe injury from foreign object ingestion is rare, continued monitoring is warranted. Health professionals are encouraged to report such injuries through the existing system.

I

Inami G.B. et al. *Detection and isolation of Salmonella from naturally contaminated alfalfa seeds following an outbreak investigation.* J Food Prot . 1999; 62(6) : 662-4.p Abstract: Naturally contaminated alfalfa seeds, epidemiologically linked to foodborne disease outbreaks in Oregon and British Columbia, were tested for the presence of Salmonella. Ten sample units from the suspected lot were sprouted and grown for 4 days. After enrichment of the grown sprouts, an enzyme immunoassay (EIA) and culture method (modified procedure of the Food and Drug Administration Bacteriological Analytical Manual) were used for the detection and isolation of Salmonella. Four of the 10 sample units were positive with the EIA; however, 5 of the 10 sample units were culture positive (four were positive for Salmonella serotype Newport and a fifth was positive for Salmonella serotype Albany and serotype Schwarzengrund). The positive alfalfa seed sample units were further tested after shredding, soaking, and washing before culturing. Results suggest that sprouting and shredding methods may yield greater detection and recovery rates of Salmonella, but more research with a larger sample size is warranted.

Inouye S. et al. *Surveillance of viral gastroenteritis in Japan: pediatric cases and outbreak incidents.* J Infect Dis. 2000; 181 Suppl 2 : S270-4.p Abstract: Surveillance results from pediatric cases and outbreaks of viral gastroenteritis in Japan are presented. In winter, both small round structured virus (SRSV, or Norwalk-like viruses) and rotavirus were detected from infants with gastroenteritis; however, in recent years, the prevailing time of SRSV infection has preceded that of rotavirus infection. Most nonbacterial gastroenteritis outbreaks were related to SRSV infection, and >60% of the outbreaks were caused by contaminated food. In small-sized outbreaks, raw oysters were the primary source of transmission. In large-sized outbreaks, school lunches and catered meals that were served at schools, banquet halls, and hospitals were most often implicated in the transmission of foodborne gastroenteritis.

Issa M.S. et al. *Fate of Listeria monocytogenes, Salmonella typhimurium DT104, and Escherichia coli O157:H7 in Labneh as a pre- and postfermentation contaminant.* J Food Prot. 2000; 63(5) : 608-12.p Abstract: Commercially pasteurized milk (approximately 2% milkfat) was heated at 85 to 87 degrees C/30 min, inoculated to contain 2,000 to 6,000 CFU/ml of Listeria monocytogenes, Salmonella typhimurium DT104, or Escherichia coli O157:H7, cultured at 43 degrees C for 4 h with a 2.0% (wt/wt) commercial yogurt starter culture, stored 12 to 14 h at 6 degrees C, and centrifuged to obtain a Labneh-like product. Alternatively, traditional salted and unsalted Labneh was prepared using a 3.0% (wt/wt) starter culture inoculum, similarly inoculated after manufacture with the aforementioned pathogens, and stored at 6 degrees C and 20 degrees C. Throughout fermentation, Listeria populations remained unchanged, whereas numbers of Salmonella increased 0.33 to 0.47 logs during the first 2 h of fermentation and decreased thereafter. E. coli populations increased 0.46 to 1.19 logs during fermentation and remained that these levels during overnight cold storage. When unsalted and salted Labneh were inoculated after manufacture, Salmonella populations decreased >2 logs in all samples after 2 days, regardless of storage temperature, with the pathogen no longer detected in 4-day-old samples. Numbers of L. monocytogenes decreased from 2.48 to 3.70 to < 1.00 to 1.95 logs after 2 days with the pathogen persisting up to 15 days in one lot of salted/unsalted Labneh stored at 6 degrees C. E. coli O157:H7 populations decreased from 3.39 to 3.7 to < 1.00 to 2.08 logs during the first 2 days, with the pathogen no longer detected in any 4-day-old samples. Inactivation rates for all three pathogens in Labneh were unrelated to storage temperature or salt content. Unlike L. monocytogenes that persisted up to 15 days in Labneh, rapid inactivation of Salmonella typhimurium DT104 and E. coli O157:H7 suggests that these emerging foodborne pathogens are of less public health concern in traditional Labneh.

J

Jackson G.J. *Public health and research perspectives on the microbial contamination of foods.* J Anim Sci. 1990; 68(3) : 884-91.p Abstract: Scientific advances in methodology and epidemiology have resulted in a renewed awareness of foodborne disease, and increased contact among nations of the world has stimulated rapid global distribution of foods as well as foodborne pathogens. New food vehicles are being identified for old, familiar pathogens, and new pathogens are being discovered. Current research in food microbiology has spurred development of rapid and

specific methods to identify these pathogens and to assess their virulence. Organisms of recent interest, such as Bacillus, Yersinia, Campylobacter, Listeria, Sporothrix, Giardia, Cryptosporidium, and Anisakis, are the foci of new investigations, as are the more familiar foodborne pathogens, Salmonella, Shigella, Clostridium, Staphylococcus, Entamoeba and Ascaris. Some foodborne organisms, such as parasitic protozoa, serve as hosts for unique bacterial and viral symbionts but also might become infected with mammalian viruses. The remote possibility of the transmission of human immunodeficiency viruses in foodborne protozoa is discussed.

Jackson S.G. *Symposium on microbiology update: old friends and new enemies. Bacillus cereus.* J Assoc Off Anal Chem. 1991; 74(4) : 704-6.p Abstract: Bacillus cereus is an environmentally ubiquitous, Gram-positive, spore-forming bacillus responsible for 2 distinct foodborne disease syndromes as well as other manifestations of pathogenicity. The rapid-onset, "emetic," foodborne-disease syndrome is associated with an emetic toxin; the delayed-onset, "diarrheal" syndrome is associated with elaboration of enterotoxin. The majority of methods for detection of these toxins have relied on in vivo testing. More recent work on purification of enterotoxin facilitated the development of a rapid, specific, fluorescent immunodot assay and a tissue culture screening assay for enterotoxin. Work on characterization and detection of emetic toxin is ongoing.

Jacobs R.J. et al. *Cost effectiveness of vaccinating food service workers against hepatitis A infection.* J Food Prot. 2000; 63(6) : 768-74.p Abstract: Foodborne transmission is an important means of hepatitis A infection that may be reduced through vaccination of food service workers (FSWs). Several states are considering actions to encourage or mandate FSW vaccination, but the cost effectiveness of such policies has not been assessed. We estimated the clinical and economic consequences of vaccinating FSWs from the 10 states with the highest reported rates of hepatitis A. A decision analytic model was used to predict the effects of vaccinating FSWs at age 20 years. It was assumed all FSWs would receive one dose of inactivated hepatitis A vaccine, and 50% would receive the second recommended dose. Parameter estimates were obtained from published reports and Centers for Disease Control and Prevention databases. The primary endpoint was cost per year of life saved (YOLS). Secondary endpoints were symptomatic infections, days of illness, deaths, and costs of hepatitis A treatment, public health intervention, and work loss. Each endpoint was considered separately for FSWs and patrons. We estimate vaccination of 100,000 FSWs would cost $8.1 million but reduce the costs of hepatitis A treatment, public health intervention, and work loss by $3.0 million, $2.3 million, and $3.1 million, respectively. Vaccination would prevent approximately 2,500 symptomatic infections, 93,000 days of illness, and 8 deaths. A vaccination policy would reduce societal costs while costing the health system $13,969 per YOLS, a ratio that exceeds generally accepted standards of cost effectiveness.

Jacquet C. et al. *Investigations related to the epidemic strain involved in the French listeriosis outbreak in 1992.* Appl Environ Microbiol. 1995; 61(6) : 2242-6.p Abstract: Two hundred seventy-nine cases of human listeriosis (92 pregnancy-related cases and 187 non-pregnancy-related cases) caused by a serovar 4b and phagovar 2389:2425:3274:2671:47:108:340 strain were identified in France between March and December 1992. Epidemiological investigations included a case-control study (not described here) and microbiological analyses of foods. Results of the case-control study and characterization of food isolates identified pork tongue in jelly, a ready-to-eat meat product, as the major vehicle of this outbreak, and to a lesser extent, delicatessen products contaminated secondarily during handling in food stores. As far as serotyping, phage typing, DNA macrorestriction pattern analysis (obtained by pulsed-field gel electrophoresis [PFGE]), and ribotyping are concerned, this epidemic strain is phenotypically and genomically closely related to strains responsible for major outbreaks of listeriosis previously observed in Europe and North America. The epidemic strain sensu stricto as defined by PFGE (2/1/3) displayed the same serovar, phagovar, ribovar, and ApaI and NotI PFGE patterns as the epidemic strains from outbreaks in Switzerland, California, and Denmark, but it consistently showed differences in the SmaI PFGE profile. This information greatly contributed to the identification of the major food vehicle (pork tongue in jelly) and further allowed exclusion of other foods (cheese) as possible sources of this major listeriosis epidemic.

Jaeger J.L. et al. *Shiga Toxin-Producing Escherichia coli.* Curr Infect Dis Rep. 2000; 2(1) : 61-67.p Abstract: Shiga toxin-producing Escherichia coli (STEC) are emerging as a significant source of foodborne infectious disease in the developed world. Multistate outbreaks of E. coli O157 and non-O157 serogroups in the United States are facilitated by the centralization of food processing and distribution. Our ability to recognize the clonality of these clusters has been advanced by developments in molecular detection techniques and in the establishment of active surveillance practices. These studies have helped identify important risk factors for both sporadic and outbreak STEC infection, allowing us to develop appropriate prevention strategies. Identification of these factors is of critical importance because of the lack of adequate treatments available. This brief review of the literature discusses major developments in the epidemiology, pathogenesis, diagnosis, treatment, and prevention of STEC disease published in the past few years.

Janisiewicz W.J. et al. *Biological control of postharvest decays of apple can prevent growth of Escherichia coli O157:H7 in apple wounds.* J Food Prot. 1999; 62(12) : 1372-5.p Abstract: Fresh cells of the antagonist Pseudomonas syringae at 2.4 x 10(8) CFU/ml inoculated into wounds of 'Golden Delicious' apple prevented Escherichia coli O157:H7 (concentrations ranging from 2.4 x 10(5) to 2.4 x

10(7) CFU/ml) from growing in the wounds. This occurred when the two microorganisms were co-inoculated or inoculation with E. coli O157:H7 was conducted 1 or 2 days after inoculation with the antagonist. In similar tests, application of the commercial formulation of this antagonist prevented the growth of E. coli O157:H7 in wounds when inoculated 1 or 2 days after application of the antagonist. Populations of E. coli O157:H7 in wounds treated with water (control) before inoculation with this pathogen increased approximately 2 log units during the first 48 h after inoculation. These results indicate that biocontrol agents developed for controlling storage decays of fruits may have the additional benefit of preventing the growth of foodborne pathogens in freshly wounded tissue of intact and fresh-cut fruits.

Jay L.S. et al. *A National Australian Food Safety Telephone Survey.* J Food Prot. 1999; 62(8) : 921-8.p Abstract: A sample of 1,203 randomly selected Australian households participated in a national telephone food safety survey. All respondents were aged 18 years or over, were the main grocery buyers of the household, purchased red meat products at least once a month, and regularly prepared food in the household. There were significant gaps observed in the food safety knowledge of many respondents surveyed. Forty percent of respondents thawed raw meat at room temperature, 85% allowed cooked foods to cool at room temperature before refrigerating, and almost 70% of respondents were not aware of the correct refrigeration temperature for storage of perishable food. Almost 25% of respondents failed to identify that washing hands before handling food and during food preparation was important in reducing the risk of cross-contamination and possible foodborne illness. Seventy-five percent of the respondents recognized that there was a likelihood of foodborne illness occurring in the home, and 25% of respondents had changed their eating habits because of publicity surrounding food poisoning outbreaks. The findings raise important concerns about domestic food handling practices in Australian homes and the level of food safety knowledge in the community generally.

Jay L.S. et al. *A video study of Australian domestic food-handling practices.* J Food Prot. 1999; 62(11) : 1285-96.p Abstract: Poor food-handling and hygiene practices in domestic kitchens are thought to be the cause of a significant amount of foodborne illness. Food-handling practices were studied by video observation in 40 home kitchens in Melbourne, Australia. Participant households included those of single people, couples, and families from a range of socioeconomic backgrounds. The kitchens were continuously video monitored for 1 or 2 weeks during 1997 and 1998. Infrequent hand washing; poor hand-washing technique; lack of hand washing prior to food preparation; inadequate cleaning of kitchen surfaces; involvement of pets in the kitchen; touching of the face, mouth, nose, and/or hair during food preparation; and lack of separate hand and dish towels were the most common unhygienic practices observed. Prior to video surveillance, participant households answered a food-safety questionnaire that related to preparation and handling of food. These answers were contrasted with the actual practices observed in each household. There was a significant variance between stated (answers provided in response to the questionnaire) and observed (via video monitoring) food-handling and hygiene practices. The results of this study raise concerns about consumer food-handling and hygiene practices in Australian domestic kitchens. A continuous and increased effort in the education of the public in the area of hygienic food preparation is indicated.

Jaykus L.A. *The application of quantitative risk assessment to microbial food safety risks.* Crit Rev Microbiol. 1996; 22(4) : 279-93.p Abstract: Regulatory programs and guidelines for the control of foodborne microbial agents have existed in the U.S. for nearly 100 years. However, increased awareness of the scope and magnitude of foodborne disease, as well as the emergence of previously unrecognized human pathogens transmitted via the foodborne route, have prompted regulatory officials to consider new and improved strategies to reduce the health risks associated with pathogenic microorganisms in foods. Implementation of these proposed strategies will involve definitive costs for a finite level of risk reduction. While regulatory decisions regarding the management of foodborne disease risk have traditionally been done with the aid of the scientific community, a formal conceptual framework for the evaluation of health risks from pathogenic microorganisms in foods is warranted. Quantitative risk assessment (QRA), which is formally defined as the technical assessment of the nature and magnitude of a risk caused by a hazard, provides such a framework. Reproducing microorganisms in foods present a particular challenge to QRA because both their introduction and numbers may be affected by numerous factors within the food chain, with all of these factors representing significant stages in food production, handling, and consumption, in a farm-to-table type of approach. The process of QRA entails four designated phases: (1) hazard identification, (2) exposure assessment, (3) dose-response assessment, and (4) risk characterization. Specific analytical tools are available to accomplish the analyses required for each phase of the QRA. The purpose of this paper is to provide a description of the conceptual framework for quantitative microbial risk assessment within the standard description provided by the National Academy of Sciences (NAS) paradigm. Each of the sequential steps in QRA are discussed in detail, providing information on current applications, tools for conducting the analyses, and methodological and/or data limitations to date. Conclusions include a brief discussion of subsequent uncertainty and risk analysis methodologies, and a commentary on present and future applications of QRA in the management of the public health risks associated with the presence of pathogenic microorganisms in the food supply.

Jaykus L.A. *Epidemiology and detection as options for control of viral and parasitic foodborne disease.* Emerg Infect Dis. 1997; 3(4) : 529-39.p Abstract: Human enteric viruses

and protozoal parasites are important causes of emerging food and waterborne disease. Epidemiologic investigation and detection of the agents in clinical, food, and water specimens, which are traditionally used to establish the cause of disease outbreaks, are either cumbersome, expensive, and frequently unavailable or unattempted for the important food and waterborne enteric viruses and protozoa. However, the recent introduction of regulatory testing mandates, alternative testing strategies, and increased epidemiologic surveillance for food and waterborne disease should significantly improve the ability to detect and control these agents. We discuss new methods of investigating foodborne viral and parasitic disease and the future of these methods in recognizing, identifying, and controlling disease agents.

Jeffrey J.S. et al. *Research notes: Prevalence of selected microbial pathogens in processed poultry waste used as dairy cattle feed.* Poult Sci. 1998; 77(6) : 808-11.p Abstract: Processed poultry litter intended for dairy cattle feed was collected on 13 dairy ranches in the San Joaquin Valley of California and analyzed for the presence of significant bacterial pathogens associated with clinical disease in cattle or foodborne disease in humans. Litter samples were collected from the surface and interior of the litter piles upon arrival on the dairies and 2 to 4 wk later. Litter samples were cultured for Salmonella, Escherichia coli, Campylobacter, and other bacteria. The temperature of the litter piles was obtained on the surface and interior at each sampling. Dry matter was determined for each sample. No Salmonella, E. coli 0157, or Campylobacter was identified (n = 104). Other E. coli strains were found in 8 out of 52 samples on arrival and 4 out of 52 samples at 2 to 4 wk after arrival. Although the surface and interior temperatures of the litter pile were different (23 C vs 50 C, respectively), the mean temperatures did not significantly change with time on the ranches. Average dry matter content did not differ between samples. In conclusion, the pathogens under investigation were not detected in processed poultry litter on these California dairy ranches upon arrival at the dairy or 2 to 4 wk later.

Jensen G.L. et al. *Public health issues in aquaculture.* Rev Sci Tech. 1997; 16(2) : 641-51.p Abstract: The authors address the public health issues associated with the consumption of aquacultural products using numerous examples from the United States of America. As with other foods, public health risks exist but these mostly involve open water environments or products which are consumed raw or undercooked. Unlike wild fisheries, inland aquaculture systems can minimise public health risks by proper site evaluation and good aquacultural practices. Responsible use of pesticides and therapeutants can prevent violative residues to assure product safety and wholesomeness. The implementation of hazard analysis and critical control point regulations will further enhance the preventive approach to hazards control. The most challenging public health risks arise from shellfish production in open, surface waters, where both naturally-occurring and trace environmental residue contaminants can bioaccumulate in tissues and may cause disease outbreaks (and, in severe cases, death). Water quality certification programmes and field surveillance efforts including product sampling, testing and monitoring can address critical safety criteria. This paper focuses primarily on public health risks associated with production: however, the fact that consumer risks also occur as a result of the processing of aquacultural products and that foodborne diseases arise additionally from unsanitary handling or preparation and storage at incorrect temperatures (as is the case for food products from other animals) must also be taken into consideration.

Jiang J. et al. *Evaluation of universal preenrichment broth for the recovery of foodborne pathogens from milk and cheese.* J Dairy Sci. 1998; 81(11) : 2798-803.p Abstract: The use of universal preenrichment broth for the recovery of verotoxigenic Escherichia coli, Salmonella spp., and Listeria monocytogenes from milk and cheese was examined. Universal preenrichment broth supported the growth of low inoculum levels (10 cfu/ml) of these organisms in pure cultures and in mixed cultures containing higher levels of other pathogens or bacterial flora from raw milk. This medium also supported the recovery and growth of heat-injured Salmonella spp., L. monocytogenes, and verotoxigenic E. coli at inoculum levels of 10(2) cfu/ml to yield cell levels of 10(8) cfu/ml in pure cultures and at least 10(5) cfu/ml in the presence of high levels of known competitive pathogens or microflora of cheese samples after 24 h of incubation. Universal preenrichment broth performed better than Listeria enrichment broth in supporting the recovery and growth of heat-injured L. monocytogenes and equally as well as buffered peptone water or trypticase soy broth in supporting the growth of uninjured L. monocytogenes, Salmonella spp., and verotoxigenic E. coli. Coenrichment of these pathogens in universal preenrichment broth reduced the quantity of milk or cheese samples that were required for analysis and also reduced the cost and labor involved in preparing and processing separate preenrichment media.

Johnston A.M. *Animal health and food safety.* Br Med Bull. 2000; 56(1) : 51-61.p Abstract: Foods of animal origin have an important role in a balanced diet and must be safe for human consumption. Equally important is the need for the food to be perceived as safe by the consumer. Safe food of animal origin must be free from animal pathogens that infect man and from contamination by residues. While intensive farming practices have been linked with the rise in foodborne illness in humans, it is interesting to note that the rise has continued even when there has been a shift to less intensive farm production systems. While the production of meat, milk and eggs, regardless of new technology or changes in production methods, cannot be expected to achieve zero bacterial risk, there is the need to reduce the risk and, where possible, eliminate it at the 'on the farm stage'. The current use of the terms 'farm-to-table', 'stable-to-table' and 'plough-to-plate' clearly identifies the farm as one part of the production chain which must be considered in terms of food safety.

Johnston M.C. et al. *Foodhandling practices of Dunedin caterers: a cause for concern.* N Z Med J. 1992; 105(938) : 289-91.p Abstract: AIM: Foodhandling practices in the Dunedin catering industry were assessed to determine if they were correct, preventing the transmission of foodborne disease to the public. METHOD: A random sample of 300 foodservice outlets was selected. Information was collected during personal interviews with managers using a prepared questionnaire. Potentially dangerous practices were further analysed and summed to identify "at risk" operations. RESULTS: Response rate was 71%. Thirty-six percent of restaurants, 27% of takeaway bars and 25% of deli-bars and butchers could have been considered at risk operations. Few managers had any formal training in preparing and serving food, and less than 20% of managers and personnel had any food hygiene training. CONCLUSIONS: Current legislation and its enforcement is unable to adequately address incorrect food handling practices. It is recommended that revisions of the law emphasise the importance of correct practices and their enforcement. Food hygiene training should become compulsory for all who work in the catering industry.

Juranovic L.R. et al. *Foodborne toxins of marine origin: ciguatera.* Rev Environ Contam Toxicol. 1991; 117 : 51-94.p Abstract: Ciguatera poisoning has long been recognized as a serious problem in the tropical and subtropical regions of the world. Due to international and interstate commerce and tourist travel the phenomenon is spreading to other parts of the globe. Various species of fish (surgeonfish, snapper, grouper, barracuda, jack, amberjack among others) have been implicated in this type of poisoning. These fish accumulate toxins in their flesh and viscera through the consumption of smaller fish that have been previously contaminated by feeding on toxic dinoflagellates. The most probable source of ciguatera is thought to be the benthic microorganism, Gambierdiscus toxicus, which produces both CTX and MTX, but other species of dinoflagellates such as Prorocentrum lima may also contribute with secondary toxins associated with the disease. Potentially ciguatoxic dinoflagellates have been isolated, cultured under laboratory conditions and dinoflagellate growth requirements as well as some factors affecting toxin production have been determined. Also, data from their ecological environment have been accumulated in an attempt to reveal a relationship with the epidemiology of ciguatera outbreaks. Several bioassays have been employed to determine the ciguatoxicity of fish. Cats have been used due to their sensitivity, but regurgitation has made dosage information difficult to obtain. Mongooses have also been used but they often carry parasitic and other type of diseases which complicate the bioassay. Mice have been used more commonly; they offer a more reliable model, can be easily housed, readily are dosed in several ways, and manifest diverse symptoms similar to human intoxications; but the amount of toxic extract needed, time consumed, complicated extraction techniques, and instrumentation involved limit the use of this assay commercially. Other bioassays have been explored including the brine shrimp, chicken, mosquito, crayfish nerve cord, guinea pig ileum, guinea pig atrium, and other histological preparations. All require elaborate time-consuming procedures, are not reproducible, lack specificity, and are semiquantitative at best. The techniques that appear to represent the major advance in identifying and detecting ciguatoxic fish are immunochemical methods: radioimmunoassay (RIA), competitive enzyme immunoassay (EIA), and enzyme-linked immunosorbent assay (ELISA). Of these, the enzyme immunoassay stick test is the simplest, fastest, most specific, more sensitive, and does not require complicated instrumentation.(ABSTRACT TRUNCATED AT 400 WORDS).

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Kaferstein F. et al. *Food safety in the 21st century.* Bull World Health Organ. 1999; 77(4) : 347-51.p Abstract: The global importance of food safety is not fully appreciated by many public health authorities despite a constant increase in the prevalence of foodborne illness. Numerous devastating outbreaks of salmonellosis, cholera, enterohaemorrhagic Escherichia coli infections, hepatitis A and other diseases have occurred in both industrialized and developing countries. In addition, many of the re-emerging or newly recognized pathogens are foodborne or have the potential of being transmitted by food and/or drinking water. More foodborne pathogens can be expected because of changing production methods, processes, practices and habits. During the early 21st century, foodborne diseases can be expected to increase, especially in developing countries, in part because of environmental and demographic changes. These vary from climatic changes, changes in microbial and other ecological systems, to decreasing freshwater supplies. However, an even greater challenge to food safety will come from changes resulting directly in degradation of sanitation and the immediate human environment. These include the increased age of human populations, unplanned urbanization and migration and mass production of food due to population growth and changed food habits. Mass tourism and the huge international trade in food and feed is causing food and feedborne pathogens to spread transnationally. As new toxic agents are identified and new toxic effects recognized, the health and trade consequences of toxic chemicals in food will also have global implications. Meeting the huge challenge of food safety in the 21st century will require the application of new methods to identify, monitor and assess foodborne hazards. Both traditional and new technologies for assuring food safety should be improved and fully exploited. This needs to be done through legislative measures where suitable, but with much greater reliance on voluntary compliance and education of consumers and professional food handlers. This will be an important task for the primary health care system aiming at "health for all".

Kaferstein F.K. et al. *Foodborne disease control: a transnational challenge.* Emerg Infect Dis. 1997; 3(4) : 503-10.p Abstract: In the globalized political economy of the late 20th century, increasing social, political, and economic interdependence is occurring as a result of the rapid movement of people, images, values, and financial transactions across national borders. Another consequence of the increase in transnational trade, travel, and migration is the greater risk of cross-border transmission of infectious diseases. As the world becomes more interconnected, diseases spread more rapidly and effectively. With more than one million people crossing international borders every day, and with the globalization of food production, manufacturing, and marketing, the risk of infectious disease transmission is greater. Economic globalization has also increased the need for governmental budget austerity, and consequent national preparedness has been eroded. The emergence of new infectious diseases, as well as the reemergence of old ones, thus represents a crucial transnational policy issue. These problems cannot be resolved by national governments alone; they require international cooperation. This article analyzes the role of foodborne disease surveillance programs, nationally and internationally, in the control of foodborne diseases.

Kaferstein F.K. et al. *Public health aspects of food irradiation.* J Public Health Policy. 1993; 14(2) : 149-63.p Abstract: In view of the enormous health and economic consequences of foodborne diseases, the World Health Organization (WHO) encourages its Member States to consider all measures to eliminate or reduce foodborne pathogens in food and improve their supplies of safe and nutritious food. With the wholesomeness of irradiated food clearly established by extensive scientific studies, food irradiation has important roles to play in both ensuring food safety and reducing food losses. Food irradiation may be one of the most significant contributions to public health to be made by food science and technology since the introduction of pasteurization. Because the promotion of a safe, nutritious and adequate food supply is an essential component of its primary health care strategy, WHO is concerned that the unwarranted rejection of this process may endanger public health and deprive consumers of the choice of food processed for safety.

Kaku M. et al. *[Food poisoning outbreak caused by Salmonella Enteritidis in the northwest of Sao Paulo State, Brazil].* Rev Saude Publica. 1995; 29(2) : 127-31.p Abstract: A foodborne outbreak which affected 211 persons occurred, in a School, in 1993. The epidemiological data obtained by interviewing the affected and non affected persons sampled showed as predominant symptoms: diarrhoea, fever (77.7%), abdominal cramps (67.7%), vomiting (65.8%), hot-and-cold sensations (54.5%) and headache (44.5%). The median incubation period was of 17 hours, the limits being 3 and 29 hours. The disease period was of from 3 to 4 days. The food concerned was a kind of pate, a mayonnaise mixture prepared with fresh eggs with boiled potatoes that was consumed with bread. The biological material analysis-3 coprocultures, and leftovers of the food revealed the presence of one and the same organism: Salmonella Enteritidis. In the food, the numbers of this bacterium per gram were sufficient to account for the manifestation of the disease (10(4) and 10(5)g). The antibiogram of all th isolates showed the same sensibility pattern. The preparation related to this outbreak suggests the endogenous contamination of the eggs; the cross contamination-the outbreak affected three school periods, as the food was prepared separately for each school period; and the conditions under which the food was kept during the time from preparation to consumption. The observation of the 3 food handlers, by successive coprocultures, for one week, indicates that they were not asymptomatic carriers nor were they affected as a result of this outbreak by the causal bacteria.

Kalchayanand N. et al. *Interaction of hydrostatic pressure, time and temperature of pressurization and pediocin AcH on inactivation of foodborne bacteria.* J Food Prot. 1998; 61(4) : 425-31.p Abstract: High hydrostatic pressure, because it can kill microorganisms, is being investigated for potential use as a nonthermal food preservation method. The objective of this study was to determine the hydrostatic pressurization parameters, pressure, time, and temperature, and a bacteriocin that in combination would destroy 7 to 8 log cycles of pathogenic and spoilage bacterial populations. We suspended cells of Staphylococcus aureus, Listeria monocytogenes, Salmonella typhimurium, Escherichia coli O157:H7, Lactobacillus sake, Leuconostoc mesenteroides, Serratia liquefaciens, and Pseudomonas fluorescens in peptone solution and exposed them to the combination of treatments. The combined parameters used were hydrostatic pressure (138 to 345 MPa), time (5 to 15 min), temperature (25 to 50 degrees C), and pediocin AcH (3,000 AU/ml, final concentration). In general, cell death increased as the pressure, time, or temperature increased; however, the cells developed proportionately greater sensitivity as the pressure increased to 276 MPa and higher and the temperature increased above 35 degrees C. Pressurization for longer than 5 min, especially at lower pressure and temperature ranges, had very little added benefit. Among the four gram-negative species, E. coli O157:H7 was the most resistant to pressurization while among the four gram-positive species, L. sake and L. mesenteroides had greater resistance. The death rate at high pressure (345 MPa) and high temperature (50 degrees C) in combination followed first-order kinetics; at lower pressure and temperature combination it showed a late tailing effect. Estimated D value data indicated that even at 345 MPa and 50 degrees C an 8-log-cycle viability loss could not be achieved within 5 min for all eight species. However, when pediocin AcH was included during pressurization this loss was achieved.

Kang D.H. et al. *Effect of diacetyl on controlling Escherichia coli O157:H7 and Salmonella Typhimurium in the presence of starter culture in a laboratory medium and during meat fermentation.* J Food Prot. 1999; 62(9) : 975-9.p Abstract: Diacetyl is a flavor compound that possesses antimicrobial activity and is found in several dairy

products. The effect of diacetyl on controlling the growth of two foodborne pathogens, Escherichia coli O157:H7 and Salmonella Typhimurium, when grown with Pediococcus acidilactici as a meat starter culture was evaluated in a laboratory medium and during salami fermentation. Diacetyl (50 ppm) added to each mixed culture system strongly inhibited the growth of E. coli O157:H7 and Salmonella Typhimurium in the laboratory medium (brain heart infusion, 2.3% of NaCl, 0.75% of dextrose) ($P < 0.05$). During meat fermentation, the growth of E. coli O157:H7 and Salmonella Typhimurium was inhibited significantly by addition of diacetyl (300 ppm) ($P < 0.05$) after 24 h fermentation. However, the acid production and growth of P. acidilactici were not affected by the addition of diacetyl ($P > 0.05$). After 24 h meat fermentation, about a 1.0-log CFU/g difference occurred in numbers of each foodborne pathogen mixed with P. acidilactici ($P < 0.05$) with and without 300 ppm diacetyl. Diacetyl and the acid produced by the meat starter culture reduced the growth of the two foodborne pathogens during salami fermentation. These results suggest that diacetyl can be used as a food ingredient during meat fermentation to control E. coli O157:H7 and Salmonella Typhimurium without harmful effects on the growth and acid production of P. acidilactici.

Kato N. et al. *Human diseases caused by exotoxins produced by anaerobes and their rapid detection.* Rinsho Biseibutshu Jinsoku Shindan Kenkyukai Shi. 1998; 9(2) : 97-104.p Abstract: Major human diseases caused by exotoxins produced by anaerobes include botulisms, tetanus, foodborne illness caused by enterotoxin-producing Clostridium perfringens, and diarrhea/colitis caused by toxigenic Clostridium difficile. Recently, enterotoxigenic Bacteroides fragilis (ETBF) has been recognized, that may be related to childhood diarrheal disease. Detection test of botulinal neurotoxin is hardly performed at clinical laboratories since the most reliable means of detection and identification of botulinal toxin is by using mouse toxicity and neutralization tests. Clinical laboratories should request the tests to a reference laboratory. Since tetanus is easily diagnosed clinically on the basis of its unique, recognizable sings, the bacteriological tests is not usually requested. C. perfringens foodborne illness can be confirmed by testing stool specimens or the suspect food(s) for enterotoxin by the reversed passive latex agglutination test or counting > 10 5 C. perfringens per g of suspected food or > 10 6 C. perfringens spores per g of stool. Diagnosis of C. difficile-associated diarrhea/colitis is confirmed by detection of toxins A or B of C. difficile and/or recovery of toxigenic C. difficile. Isolation of C. difficile strains or detection C. difficile-speciffic antigen from stool specimens is less diagnostic since nontoxic or toxin A positive-toxin B negative strains are prevalent in Japan. Reliable laboratory tests for ETBF-associated childhood diarrhea are not established yet although ETBF can be proved by polymerase chain reaction for detection of the enterotoxin gene.

Katz D. et al. *Cyclosporiasis associated with imported raspberries, Florida, 1996.* Public Health Rep. 1999; 114(5) : 427-38.p Abstract: OBJECTIVES: Until 1995, infection with Cyclospora cayetanenis, a parasite that causes gastroenteritis, was diagnosed in the US primarily in overseas travelers; its modes of transmission were largely unknown. In 1995, 45 cases of cyclosporiasis were diagnosed in Florida residents who had no history of recent foreign travel, but an investigation could not pinpoint a source for the parasite. In 1996, a North American outbreak of cyclosporiasis resulted in more than 1400 cases, 180 of them in Florida. The authors investigated the 1996 Florida outbreak to identify the vehicle of transmission. METHODS: The authors conducted a matched case-control study in which each of 86 laboratory-confirmed sporadic cases was matched with up to four controls. They also investigated nine clusters of cases associated with common meals and attempted to trace implicated foods to their countries of origin. RESULTS: In the case control study, eating raspberries was strongly associated with cyclosporiasis (matched odds ratio = 31.9; 95% confidence interval [CI] 7.4, 138.2). In the cluster investigation, raspberries were the only food common to all nine clusters of cases; a summary analysis showed a strong association between consumption of raspberries and confirmed or probable cyclosporiasis (risk ratio = 17.6; 95% CI 1.9, 188.8). Guatemala was the sole country of origin for raspberries served at six of nine events. CONCLUSIONS: Guatemalan raspberries were the vehicle for the 1996 Florida cyclosporiasis outbreak. Cyclospora is a foodborne pathogen that may play a growing role in the etiology of enteric disease in this country as food markets become increasingly international.

Kello D. *Epidemiological aspects in food safety.* Food Addit Contam . 1990; 7 Suppl 1 : S5-11.p Abstract: The rapid growth of international trade in food products has resulted in increased hazards from trans-boundary foodborne infections and intoxication. Therefore, the development of multinational surveillance and registration of foodborne diseases or food contamination, of both biological and chemical origin, is of utmost importance for their prevention and control. Recognizing the importance of accurate and adequate epidemiological data for decision making with respect to priorities, resources and management, the World Health Organization (WHO) launched in 1976 the Joint UNEP/FAO/WHO Food Contamination Monitoring Programme (GEMS/Food) and in 1980 the surveillance programme for control of foodborne infections and intoxications in Europe. Although the response of participating countries in both programmes was very positive, many questions have arisen during this period which require further improvements through national and international action. Monitoring and surveillance of food contamination and foodborne infections and intoxications is a multidisciplinary process and requires the active involvement of experts in medical and veterinary food hygiene, food chemistry and epidemiology. Since health risk management with respect to food safety is frequently delegated to different authorities, much better coordination between the sectors is needed in order to improve epidemiological analysis at national and international level. The purpose of this paper

is to review the WHO regional programme for prevention and control of foodborne infections and intoxications in the light of accumulated experience and to discuss plans and possibilities for further improvements through national and international action in the 1990s.

Khambaty F.M. et al. *Application of pulsed-field gel electrophoresis to the epidemiological characterization of Staphylococcus intermedius implicated in a food-related outbreak.* Epidemiol Infect. 1994; 113(1) : 75-81.p Abstract: An outbreak of food intoxication involving over 265 cases in western United States occurred in October 1991. Staphylococcus intermedius was implicated as the aetiologic agent. Representative outbreak isolates (five clinical and ten from foods) produced type A enterotoxin. DNA fragments generated by four restriction endonucleases and analysed by pulsed-field gel electrophoresis (PFGE) provided definitive evidence that all isolates from nine different counties in California and Nevada were derived from a single strain. The PFGE pattern of these outbreak isolates was distinct from those of a heterogeneous collection of seven S. intermedius strains of veterinary origin and five unrelated S. aureus laboratory strains. The data show a significant PFGE pattern heterogeneity not only among members of different Staphylococcus species but also within members of the same species and even the same enterotoxin type. The results indicate that PFGE is a valuable strain-specific discriminator for the epidemiological characterization of S. intermedius. To our knowledge, this represents the first documented foodborne outbreak caused by S. intermedius. These findings suggest that the presence of S. intermedius and other species such as S. hyicus in food should be reason for concern.

Khamboonruang C. et al. *Application of hazard analysis critical control point (HACCP) as a possible control measure for Opisthorchis viverrini infection in cultured carp (Puntius gonionotus).* Southeast Asian J Trop Med Public Health. 1997; 28 Suppl 1 : 65-72.p Abstract: Opisthorchiasis due to Opisthorchis viverrini and transmitted through infected freshwater cyprinoid fish (carps) affects more than 8 million people in Thailand, People's Democratic Republic of Lao, and Vietnam. The Hazard Analysis Critical Control Point (HACCP)-concept has been recommended by FAO and WHO to be included in programs to control foodborne trematode infections (FBT). HACCP is a multifactorial approach to control food hazards through surveillance of diseases, foods, and operations and education. This study describes the first attempt to apply HACCP to the prevention and control of Opisthorchis viverrini in pond culture carp (Puntius gonionotus). The experiment was designed and carried out by a multidisciplinary "HACCP team" including experts in the field of public health, parasitology, epidemiology, aquaculture, fisheries extension and fish inspection. The investigation was performed in two fish ponds in the District of Sun Pa Tong, Chiang Mai, Thailand. In the experimental pond, fish was cultured according to HACCP principles and compared with the control pond, which followed conventional aquaculture practices. Water supply to the pond, fish fry, fish feed and pond conditions during the growing period were identified as critical control points (CCPs). Hazards were identified and analyzed, as well as control measures, critical limits, monitoring procedures, corrective actions, and record keeping developed for each one of the above CCPs. Complete pond preparation, particularly aiming to eliminate contamination of pond water with O. viverrini eggs, fish infected with parasite meacercariae and the first intermediate host (Bithynia spp), was conducted. After the pond was filled with water, O. viverrini metacercaria-free fry were released into the pond. The preliminary results obtained indicate that HACCP-based principles applied to carp pond culture could be used as a strategy to prevent and control O. viverrini. Further studies should be undertaken aiming to confirm these preliminary results.

Kilsby D.C. *Food microbiology: the challenges for the future.* Int J Food Microbiol. 1999; 50(1-2) : 59-63.p Abstract: Food microbiology has become a mature science in the twentieth century and has made great advances. While recognising these achievements, it is also necessary to consider how the science may need to change. This paper addresses this by reference to three areas. These are possible changes in foodborne diseases of concern and the impact of molecular and genetic techniques on our current methodology. The recognition of the role of food and associated microbial contaminants in chronic diseases could become a major concern. New developments in our understanding of microbial genetics could affect our concepts of bacterial taxonomy. The current methodologies we use, based upon genotypically identical populations, may need to be addressed. If the trends indicated here are realised, they indicate a major challenge and opportunity for the food microbiologist.

Kinderlerer J.L. *Czapek casein 50% glucose (CZC50G): a new medium for the identification of foodborne Chrysosporium spp.* Lett Appl Microbiol. 1995; 21(2) : 131-6.p Abstract: A new medium Czapek Casein 50% Glucose agar (CZC50G) has been developed, on which the four foodborne Chrysosporium spp., C. xerophilum, C. inops, C. farinicola and C. fastidium can be distinguished by differences in growth rates and colony morphology. Chrysosporium xerophilum and C. inops both produced dense white colonies, but C. xerophilum grew faster than C. inops, 22 mm in 14 d compared to 9-12 mm in 14 d at 25 degrees C. Some isolates produced a yellow or red reverse due to the reaction of ferric ammonium citrate incorporated in the medium with a fungal metabolite. Chrysosporium farinicola and C. fastidium both grew poorly on this medium and produced sparse colonies: C. farinicola grew faster. Electron micrographs of arthroconidia with a cryo-scanning electron microscope showed thickening of the spore walls in C. inops but not in C. xerophilum. The aleurioconidia of C. farinicola and C. fastidium were different in shape. The differences in colony morphology and growth rate on CZC50G reflected these differences and

demonstrated that these four species could be distinguished easily on CZC50G.

Klein G. *[Food as a potential vector for antibiotic resistance. 1. Relevance of residues and selected foodborne infections and intoxicants]*. Berl Munch Tierarztl Wochenschr. 1999; 112(10-11) : 365-9.p Abstract: Food of animal origin has been considered as an important vector for the transfer of antibiotic resistances from animal to man. Such a transfer is possible by three ways: through antibiotic residues in food, through the transfer of resistant foodborne pathogens or through the ingestion of resistant parts of the original food microflora and resistance transfer to pathogenic microorganisms. A literature review and own investigations were performed in order to asses the potential impact of antibiotic resistance in food on the consumer health. In the first report Salmonella and Staph, aureus isolates were screened for their antibiotic resistance profiles. As a result it could be shown that residues in fresh meat or milk are quantitatively of minor interest. The resistance profile of Salmonella depended on the origin (pig or poultry), but only serovars could be identified which are generally not responsible for systemic infections. Staph. aureus isolates did not show any resistances relevant for human medicine. In these cases food can be considered as safe concerning its role as a vector for antibiotic resistances. However, a resistance monitoring seems to be necessary.

Klontz K.C. et al. *Age-dependent resistance factors in the pathogenesis of foodborne infectious disease.* Aging (Milano). 1997; 9(5) : 320-6.p Abstract: With increasing age there is an increase in both the incidence as well as the mortality due to many infectious illnesses, and foodborne infectious disease is no exception. A review of the pertinent literature identified studies concerning foodborne disease caused by infectious agents in the elderly, as well as those factors that could account for the increase in morbidity and mortality seen in the elderly due to foodborne infections. The published information suggested that the basis for the increased incidence, severity and risk of death of many foodborne infectious diseases in elderly persons is related to factors such as reduced gastric acidity, a higher prevalence of underlying medical disorders (co-morbidity factors), and immune system changes that result in a less effective host defense against infectious agents. The greater risk of foodborne disease experienced by elderly persons results from the contribution of non-immune and immune mediated factors. Due to the growing number of persons over the age of 65 years in the United States, foodborne disease in this age group will continue to be an important source of illness and death in the population.

Kohlmeier L. et al. *Dietary modifiers of carcinogenesis.* Environ Health Perspect. 1995; 103 Suppl 8 : 177-84.p Abstract: Dietary components express a wide range of activities that can affect carcinogenesis. Naturally occurring substances in foods have been shown in laboratory experiments to serve as dietary antimutagens, either as bioantimutagens or as desmutagens. Dietary desmutagens may function as chemical inactivaters, enzymatic inducers, scavengers, or antioxidants. Dietary components may also act later in the carcinogenic process as tumor growth suppressors. Examples of dietary factors acting in each of these stages of carcinogenesis are presented, and potential anticarcinogens such as the carotenoids, tocopherols, phenolic compounds, glucosinolates, metal-binding proteins, phytoestrogens, and conjugated linoleic acid are discussed. Individual foods typically contain multiple potential anticarcinogens. Many of these substances can influence carcinogenesis through more than one mechanism. Some substances exhibit both anticarcinogenic and carcinogenic activity in vitro, depending on conditions. Epidemiologic research indicates that high fruit and vegetable consumption is associated with lower cancer risk. Little research has focused on the effects of single substances or single foods in man. Realization of the potential of foodborne substances to reduce the human burden of cancer will only be achieved with better measurement of dietary exposures and funding of multidisciplinary research in this area commensurate with its importance.

Korsak N. et al. *An efficient sampling technique used to detect four foodborne pathogens on pork and beef carcasses in nine Belgian abattoirs.* J Food Prot. 1998; 61(5) : 535-41.p Abstract: The method presented in this paper should prove useful in assessing the effectiveness of HACCP plans developed in slaughterhouses. Samples were collected by swabbing well-defined areas of pork and beef carcasses with sterile gauze. Between 160 and 420 half-carcasses were swabbed in each of nine pork or beef slaughterhouses. Swabs from five carcasses were placed in the same sterile Stomacher bag, constituting a single composite sample. Standard or validated analytical methods were used to isolate and characterize four foodborne pathogens. Salmonella spp., Listeria monocytogenes, Campylobacter spp., and verocytotoxin-producing E. coli were detected, respectively, in 27, 2, 2, and 14% of the pork samples and 0, 22, 10, and 5% of the beef samples. Of the 10 samples positive for E. coli O157, only one yielded an isolate confirmed to be enterohemorrhagic. Since Salmonella spp. appear as the main contaminant port (27%) and L. monocytogenes as the main containment of beef (22%), any slaughterhouse sampling plan should include testing for the former in the case of pork carcasses and for the latter in the case of beef carcasses. One should also test regularly for the presence of E. coli O157 and Campylobacter spp. in pork and beef abattoirs. The method presented here is an easy way to assess the contamination rate of carcasses at the end of the slaughtering process.

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Laberge I. et al. *Prevalence, detection and control of Cryptosporidium parvum in food.* Int J Food Microbiol. 1996; 32(1-2) : 1-26.p Abstract: The role of Cryptosporidium parvum as a foodborne pathogen has not been well documented. Epidemiological features of this

parasitic protozoon lead to the assumption that the incidence of cryptosporidiosis due to contaminated food is under-estimated. The high prevalence of C. parvum among dairy herds has increased the spread of oocysts in the farm environment, and their potential presence in raw milk and other raw foods. In October 1993, the first well-documented foodborne outbreak was reported in Maine, USA, and was caused by contaminated hand-pressed apple cider. Although various cases of cryptosporidiosis among humans have pointed to raw milk and other raw foods as possible sources of infection, a conclusive demonstration of foodborne cryptosporidiosis has rarely been established. The limited numbers of oocysts in the suspected samples and the lack of sensitive detection methods adapted for oocyst detection in food contribute to this under-reporting. This review paper discusses various aspects of Cryptosporidium spp. and cryptosporidiosis, including the routes of transmission, the control of oocysts in food, and the available detection methods. The polymerase chain reaction (PCR) combined with DNA probe hybridization is a promising detection method. Recent knowledge on the molecular biology of the parasite for the development of new PCR assays and their potential use in the detection of C. parvum in food are described.

Lachowicz K.J. et al. *The synergistic preservative effects of the essential oils of sweet basil (Ocimum basilicum L.) against acid-tolerant food microflora.* Lett Appl Microbiol. 1998; 26(3) : 209-14.p Abstract: Essential oils extracted by hydrodistillation from five different varieties of Ocimum basilicum L. plants (Anise, Bush, Cinnamon, Dark Opal and a commercial sample of dried basil) were examined for antimicrobial activity against a wide range of foodborne Gram-positive and -negative bacteria, yeasts and moulds by an agar well diffusion method. All five essential oils of basil showed antimicrobial activity against most of the organisms tested with the exception of Flavimonas oryzihabitans and Pseudomonas species. The inhibitory effect of Anise oil, in comparison with mixtures of the predominant components of pure linalool and methyl chavicol, against the acid-tolerant organisms, Lactobacillus curvatus and Saccharomyces cerevisiae, was examined in broth by an indirect impedance method. Synergistic effects between Anise oil, low pH (pH 4.2) and salt (5% NaCl) were determined. The antimicrobial effect of Anise oil was also assessed in a tomato juice medium by direct viable count, showing that the growth of Lact. curvatus and S. cerevisiae was completely inhibited by 0.1% and 1% Anise oil, respectively. The results of the current study indicate the need for further investigations to understand the antimicrobial effects of basil oils in the presence of other food ingredients and preservation parameters.

Laconcha I. et al. *Phage typing combined with pulsed-field gel electrophoresis and random amplified polymorphic DNA increases discrimination in the epidemiological analysis of Salmonella enteritidis strains.* Int J Food Microbiol. 1998; 40(1-2) : 27-34.p Abstract: Phage typing (PT) combined with pulsed-field gel electrophoresis (PFGE) and a random amplified polymorphic DNA (RAPD) fingerprinting method was used to characterize Salmonella enteritidis strains. Twenty-four epidemiologically unrelated isolates, sampled from diverse ecological niches and fifteen isolates from four well-defined outbreaks of foodborne gastroenteritis, were studied. Seven phage types, with a predominance of PT 4 (63% of isolates), were observed when analysing the epidemiologically unrelated group. PT 4 was detected in all of the ecological niches studied, including food and fecally polluted river and beach water. The discriminatory power for phage typing, the average probability that the typing system will assign a different type to two unrelated strains randomly sampled in the microbial population, was 0.62. Ten PFGE pattern types were obtained with Xba I restriction endonuclease enzyme among the unrelated isolates; thirteen isolates belonged to PFGE pattern type 1 and the rest of the PFGE types were assigned to one or two isolates. The Dice coefficient clustered the similarities of the PFGE patterns between 80-100%. PFGE showed a discriminatory power of 0.72. Five clearly distinct RAPD patterns were observed with the OPS-19 oligonucleotide, but the discrimination obtained was low (0.46). The combination of the three typing methods increased the number of types to seventeen, giving high discrimination (0.92). Seven of the isolates recovered from various ecological niches belonged to the combination PT 4/PFGE 1/RAPD A and other combinations were unique or included only two strains. The four epidemiologically well-defined foodborne outbreaks were associated with the PT 4 phage type. In two of the outbreaks, other phage types (PT 7a and RDNC) were also observed in two isolates. Most of the isolates belonging to the foodborne outbreaks had an identical PFGE pattern (PFGE pattern type 1), but a difference in a restriction band was observed in an isolate belonging to an outbreak. Two RAPD patterns were observed in the outbreaks; RAPD pattern type A was detected in three of the four outbreaks. When the combined typing method was applied to the study, high concordance was observed and most of the outbreak strains belonged to the combination PT 4/PFGE 1/RAPD A. It is concluded that the combination of phage type with PFGE and RAPD provides a powerful discriminatory tool for the epidemiological analysis of unrelated and related strains of S. enteritidis.

Lagarrigue S. et al. *Suppression of oncogene-induced transformation by quercetin and retinoic acid in rat liver epithelial cells.* Cell Mol Biol Res. 1995; 41(6) : 551-60.p Abstract: AP1 is a heterodimeric complex containing products of the Jun and Fos oncogene families. The c-fos and c-jun protooncogenes act as transcriptional activator for numerous cellular genes, and the overexpression of these genes may cause malignant transformation. In this study, to show evidence of a possible inhibition of AP1 transcriptional activity in molecular mechanisms of foodborne molecules, known to be negative modulators of carcinogenesis, we established two rat liver epithelial (REL) cell lines overexpressing either c-fos (43C line) or c-jun (RELcJ1 line) oncoproteins. Contrary to the 43C line, which was spontaneously transformed, the c-jun-transfected REL cells were only transformed in vitro after 12-O-tetra-decanoylphorbol 13-acetate (TPA) exposure.

All trans-retinoic acid (RA) abolished the transformation of the 43C line and TPA-treated RELcJ1 cells, suggesting that RA could decrease AP1 activity in these cells despite c-fos or c-jun overexpression. Furthermore, we show for the first time that a flavonoid, quercetin, which is a natural component of vegetables, inhibited only the transformation of the 43C line. The spontaneous transformation of the c-fos-transfected REL cells was associated with the appearance of c-fos/AP1 complexes binding TRE, suggesting that c-fos/AP1 complexes are involved in the antitransforming mechanism of quercetin.

Lake R.J. et al. *Estimated number of cases of foodborne infectious disease in New Zealand.* N Z Med J. 2000; 113(1113) : 278-81.p Abstract: AIMS: To estimate the annual number of cases of infectious intestinal disease caused by foodborne pathogens in New Zealand and estimate the impact of these diseases in terms of days lost to illness. METHODS: Incidence of foodborne diseases were derived from data from infectious disease surveillance and hospital sources, and estimates of unreported illnesses using published population based studies. RESULTS: The estimated number of cases of foodborne infectious disease is approximately 119 000 per year, including 19 000 general practitioner visits, 400 hospital admissions, 22 cases of long term illness and two deaths. It is estimated that the number of cases of potentially foodborne infectious disease is approximately 199 000. Total number of cases of all infectious intestinal disease could be as high as 823 000. Days of lost production and leisure time activities lost to foodborne infectious disease are estimated as approximately 497 000. CONCLUSION: Foodborne infectious diseases represent a major public health burden in terms of the number of cases and days lost to illness.

Lambl B.B. et al. *Malabsorption and wasting in AIDS patients with microsporidia and pathogen-negative diarrhea.* AIDS. 1996; 10(7) : 739-44.p Abstract: OBJECTIVE: To define the clinical syndrome, nutritional status and malabsorptive status in patients with HIV and chronic diarrhea and either microsporidia or no identified pathogen. PATIENTS: HIV-positive patients from an urban, hospital-based infectious disease clinic with chronic diarrhea who had undergone exhaustive gastrointestinal and stool studies for enteric pathogens and were found to have either microsporidia or no pathogen. METHODS: Patients were evaluated for clinical history, physical, body composition, nutritional and malabsorptive studies including D-xylose, Schilling test, determinations of 24 h stool fat, weight and nitrogen, and 24 h urea nitrogen. RESULTS: Ten patients with microsporidia were studied, four of whom were infected with Septata intestinalis, six with Enterocytozoon bieneusi; nine patients had no identified pathogen. Patients in both groups were comparable in stage of HIV disease, and demonstrated abnormal nutritional status and malabsorptive parameters. Patients with no pathogen had significantly longer duration of symptoms prior to presentation; however, patients with microsporidia had significantly greater malabsorption of fat, D-xylose, vitamin B12, and significantly lower serum levels of zinc. Nutritional status and malabsorption were similarly depressed in patients infected with either species of microsporidia. CONCLUSION: HIV-infected patients with chronic diarrhea associated with either microsporidial infection or with no identified pathogen had abnormal parameters of absorption and malnutrition, and those infected with microsporidia demonstrated more severe malabsorption.

Lammerding A.M. et al. *Hazard identification and exposure assessment for microbial food safety risk assessment.* Int J Food Microbiol. 2000; 58(3) : 147-57.p Abstract: The four cornerstones of microbial food safety risk assessment are hazard identification, exposure assessment, hazard characterization, and risk characterization. These steps represent a systematic process for identifying adverse consequences and their associated probabilities arising from consumption of foods that may be contaminated with microbial pathogens and/or microbial toxins. This paper presents a discussion of the first two steps: hazard identification and exposure assessment, and considerations for different approaches that can be used to analyze the relevant information.

Lammerding A.M. et al. *Quantitative risk assessment: an emerging tool for emerging foodborne pathogens.* Emerg Infect Dis. 1997; 3(4) : 483-7.p Abstract: New challenges to the safety of the food supply require new strategies for evaluating and managing food safety risks. Changes in pathogens, food preparation, distribution, and consumption, and population immunity have the potential to adversely affect human health. Risk assessment offers a framework for predicting the impact of changes and trends on the provision of safe food. Risk assessment models facilitate the evaluation of active or passive changes in how foods are produced, processed, distributed, and consumed.

Lange W.R. *Ciguatera fish poisoning.* Am Fam Physician. 1994; 50(3) : 579-84.p Abstract: Ciguatera fish poisoning is the most common foodborne illness related to fin fish consumption and is endemic throughout the Caribbean and Indo-Pacific regions. The clinical picture is characterized by a variety of gastrointestinal, neurologic and, occasionally, cardiovascular symptoms. Patients with bradycardia and/or hypotension may require urgent care. Neurologic symptoms tend to be the most distinctive and enduring and include sensory changes such as generalized pruritus, circumoral numbness and reversal of hot and cold sensation. Intravenous mannitol has evolved as a unique remedy for patients with acute poisoning, but management of chronic symptoms continues to be problematic. Though difficult to implement, preventive strategies remain the best defense.

Lantelme P. et al. *[Clostridium perfringens septicemia associated with foodborne toxic infection and abortion].* Ann Fr Anesth Reanim. 1995; 14(4) : 359-61.p Abstract: A 32-year-old pregnant woman with poor life and hygiene conditions presented with premature labour, fever and

diarrhoea. After admission she gave birth to a stillborn child. The examination revealed a septicaemia with massive haemolysis and renal failure. Six blood cultures obtained on admission yielded Clostridium perfringens. The outcome was favourable after an adapted antibiomicrobial therapy. This case illustrates the potential severity of Clostridium perfringens foodborne toxi-infection which can lead to abortion and septicaemia with massive haemolysis.

Layton M.C. et al. *A mixed foodborne outbreak with Salmonella heidelberg and Campylobacter jejuni in a nursing home.* Infect Control Hosp Epidemiol . 1997; 18(2) : 115-21.p Abstract: OBJECTIVE: To investigate a mixed Salmonella heidelberg and Campylobacter jejuni foodborne outbreak in a nursing home. DESIGN: Retrospective cohort study with a nested case-control design. Cases were defined by positive stool-culture results. Controls needed to be both asymptomatic and culture-negative. SETTING AND PATIENTS: Residents of a 580-bed nursing home in Brooklyn, New York. RESULTS: Of the 580 residents, 119 (21%) developed illness. Of the 93 symptomatic patients who submitted specimens, cultures were positive for S heidelberg in 24 (26%), C jejuni in 14 (15%), and both microorganisms in 25 (27%). Only the pureed diet was associated highly with infection by either Salmonella (odds ratio [OR], 17.6; 95% confidence interval [CI95], 4.8-68.7; P < .001), Campylobacter (OR, 13.3; CI95, 3.2-59.2; P < .001), or both organisms (OR, 8.9; CI95, 2.7-30.3; P < .001). Among the 42 pureed foods served during the 5 days before the outbreak, five meat or poultry items were associated most strongly with culture positivity. Of these five meat items, only a chopped-liver salad was implicated by the two employees reporting illness. A reported food-handling error occurred when ground, cooked chicken livers were placed in a bowl containing raw chicken-liver juices. INTERVENTION: Recommendations for proper cleaning and sanitizing of kitchen equipment to prevent cross-contamination between raw and cooked foods. CONCLUSIONS: Mixed foodborne outbreaks occur rarely. During this outbreak, contamination of a single food item with multiple bacterial pathogens was the likely source of transmission. Improper food-handling techniques that promote growth of one microorganism also allow growth of other pathogens that may be present. Because different sources and routes of transmission may be implicated for different pathogens, specific preventive measures may vary depending on the organisms involved.

Lee C.C. et al. *Foodborne diseases.* Singapore Med J. 1996; 37(2) : 197-204.p Abstract: Foodborne diseases continue to cause significant morbidity and mortality both in developing and developed countries. Its spectrum has vastly expanded in recent years with the recognition of new foodborne pathogens and clinical syndromes. The increase in international travel and demand for exotic and raw food underscore the importance of traveller's diarrhoea. The emergence of day care centres and residential institutions predispose to an environment that enhances the transmission of foodborne pathogens. Last but not least, our greying population, the AIDS pandemic and increasing use of immunosuppressive chemotherapy have produced a special population that is easily susceptible to the microbial contamination of food. Diseases in these individuals are usually more chronic, severe or life-threatening. This article seeks to address the above issues as well as to present a practical approach to the diagnosis and management of foodborne diseases.

Lee C.Y. et al. *Characterization of a cloned pR72H probe for Vibrio parahaemolyticus detection and development of a nonisotopic colony hybridization assay.* Microbiol Immunol. 1995; 39(3) : 177-83.p Abstract: Vibrio parahaemolyticus is a halophilic bacterium often found in shellfish and is an important causative agent of food poisoning in Taiwan. A rapid and efficient detection method is required to identify this foodborne pathogen. A 0.76-Kb HindIII DNA fragment was cloned from the chromosomal DNA of V. parahaemolyticus strain no. 93, designated as pR72H fragment, was used as a polynucleotide probe. It was labeled with digoxigenin-11-dUTP (DIG) by the random primer-labeling method. The sensitivity and specificity of the digoxigenin-labeled 0.76-Kb DNA probe was determined by colony hybridization assay. Under stringent hybridization conditions, 122 of 124 isolates of V. parahaemolyticus showed positive hybridization reaction with DIG-0.76-Kb DNA probe; the negative strains were attributed to slow growth. The DIG-0.76-Kb probe did not hybridize with 86 isolates of other vibrios and a number of other enterics as well as nonenteric microorganisms. The sensitivity and specificity of this DIG probe are 98% and 100%, respectively. This nonisotopic colony hybridization assay can be very useful for routine monitoring of V. parahaemolyticus in the food industry, environmental analysis and clinical laboratories.

Lee L.A. et al. *An outbreak of shigellosis at an outdoor music festival.* Am J Epidemiol. 1991; 133(6) : 608-15.p Abstract: In August 1988, an estimated 3,175 women who attended a 5-day outdoor music festival in Michigan became ill with gastroenteritis caused by Shigella sonnei. Onset of illness peaked 2 days after the festival ended, and patients were spread throughout the United States by the time the outbreak was recognized. An uncooked tofu salad served on the last day was implicated as the outbreak vehicle (odds ratio = 3.4, p less than 0.0001). Over 2,000 volunteer food handlers prepared the communal meals served during the festival. This large foodborne outbreak had been heralded by a smaller outbreak of shigellosis among staff shortly before the festival began and by continued transmission of shigellosis from staff to attendees during the festival. S. sonnei isolated from women who became ill before, during, and after the festival had identical antimicrobial susceptibility patterns and plasmid profiles. Limited access to soap and running water for handwashing was one of the few sanitary deficits noted at this gathering. This investigation demonstrates the need for surveillance and prompt public health intervention when Shigella infections are recognized in persons attending mass outdoor gatherings, the singular importance

of handwashing in reducing secondary transmission of shigellosis, and the potential for explosive outbreaks when communal meals are prepared by large numbers of food handlers.

Lee S. et al. *dsRNA associated with virus-like particles in Eimeria spp. of the domestic fowl.* Parasitol Res. 1996; 82(6) : 518-23.p Abstract: RNA segments, identified as double-stranded, were found in sporozoites of the Guelph strains of Eimeria acervulina, E. brunetti, E. maxima and E. necatrix and in 8 of 11 strains of E. acervulina obtained from poultry houses across the United States. These RNAs were resistant to RNase A digestion in the presence of high salt concentrations (0.3 M NaCl). On agarose-gel electrophoresis, E. acervulina had one obvious band at 1.7 kb and a faint band at 3.5 kb; E. brunetti had two bands at 2.1 and 3.3 kb, respectively; E. maxima had one band at 4.5 kb; and E. necatrix had two major bands at 4.5 and 5.6 kb, respectively. No dsRNA band was seen in the three strains of E. tenella examined. Virus-like particles were purified by cesium chloride density centrifugation of homogenates of E. necatrix sporulated oocysts. The fraction at peak virus concentration had a buoyant density of 1.39 g ml-1. These virus-like particles were icosahedral, had no envelope and measured 42-44 nm in diameter. Only one RNA band at 5.6 kb was observed when nucleic acids from gradient fractions containing virus were subjected to electrophoresis. The 4.5-kb dsRNA segment of E. necatrix was not associated with a virus-like particle.

Leister D. et al. *A PCR-based approach for isolating pathogen resistance genes from potato with potential for wide application in plants.* Nat Genet. 1996; 14(4) : 421-9.p Abstract: Plant genes for pathogen resistance can be used to engineer disease resistant crops. Oligonucleotides were designed from sequence motifs conserved between resistance genes of tobacco and Arabidopsis thaliana and used as PCR primers in potato DNA. Amplification products were obtained that were homologous to known resistance genes and linked without recombination with the nematode resistance locus Gro1 and the Phytophthora infestans resistance locus R7 of potato. Map positions of PCR-derived potato gene fragments were also correlated with resistance loci of the related tomato and tobacco genomes. Our results indicate that plant resistance genes that are effective against nematodes, fungi, viruses and bacteria may be isolated based on common sequence motifs and PCR methodology.

Levine W.C. et al. *Staphylococcal food poisoning caused by imported canned mushrooms.* J Infect Dis. 1996; 173(5) : 1263-7.p Abstract: From February through April 1989, four outbreaks of staphylococcal food poisoning in the United States were associated with eating mushrooms canned in the People's Republic of China (PRC). In the four outbreaks, 99 persons who ate at a suspect facility developed gastrointestinal symptoms within 24 h, including 18 who were hospitalized. Illness was associated with eating mushrooms at a university cafeteria (relative risk [RR] = 53.0), a hospital cafeteria (RR = 13.8), a pizzeria (odds ratio [OR] = infinity), and a restaurant (OR = infinity) (all P < .0001). Staphylococcal enterotoxin A was found by ELISA in mushrooms at the sites of two outbreaks and in unopened cans from the three plants thought to have produced mushrooms implicated in outbreaks. These investigations led to multistate recalls and a US Food and Drug Administration order to restrict entry into the United States of all mushrooms produced in the PRC; until this action, the United States imported approximately 50 million pounds yearly.

Levine W.C. et al. *Foodborne disease outbreaks in nursing homes, 1975 through 1987.* JAMA. 1991; 266(15) : 2105-9.p Abstract: OBJECTIVE.--To describe the epidemiology of foodborne disease outbreaks in nursing homes and to identify where preventive efforts might be focused. DATA SOURCES.--Reports by state and local health departments of foodborne disease outbreaks occurring from January 1, 1975, through December 31, 1987. STUDY SELECTION.--Foodborne disease outbreaks reported to the Centers for Disease Control, Atlanta, Ga, on standard investigation forms. DATA EXTRACTION.--Each foodborne disease outbreak report was examined by an epidemiologist or statistician. Outbreaks were considered to have a known pathogen if confirmed by laboratory tests, and a known vehicle when an epidemiologic investigation implicated a specific food item. DATA SYNTHESIS.--From 1975 through 1987, 26 states reported 115 outbreaks of foodborne disease in nursing homes, causing illness in 4944 persons and death in 51. These outbreaks represented 2% of all reported foodborne disease outbreaks and 19% of outbreak-associated deaths in this period. Of 52 outbreaks with a known cause, Salmonella was the most frequently reported pathogen, accounting for 52% of outbreaks and 81% of deaths. Salmonella enteritidis outbreaks accounted for 56% of the Salmonella-associated deaths since 1981. The implicated food vehicles in S enteritidis outbreaks were made with eggs or prepared with equipment contaminated with eggs. Staphylococcal foodborne disease was the next most commonly identified cause, accounting for 23% of outbreaks. CONCLUSIONS.--Since the elderly are at high risk for serious morbidity from foodborne disease, nursing homes should practice careful food handling, preparation, and storage procedures; provide education for food handlers; and have active infection control programs to rapidly detect and control outbreaks of foodborne disease.

Lew J.F. et al. *An outbreak of shigellosis aboard a cruise ship caused by a multiple-antibiotic-resistant strain of Shigella flexneri.* Am J Epidemiol. 1991; 134(4) : 413-20.p Abstract: From October 23 to October 27, 1989, an outbreak of gastroenteritis occurred aboard a cruise ship in the Caribbean. The 818 passengers and 518 crew members were surveyed for gastrointestinal symptoms; 72 (14%) of 512 passengers and 12 (3%) of 388 crew members who answered the survey reported having a diarrheal illness. Multiple-antibiotic-resistant Shigella flexneri 4a was isolated from 19 ill passengers and two ill crew members.

Thirteen people were hospitalized, and prolonged duration of illness was associated with taking an antibiotic to which the isolated strain of Shigella was resistant. A case-control study of food items implicated German potato salad as the vehicle of transmission. It was prepared and probably infected by a food handler from a country where multiple-antibiotic-resistant Shigella is common. Spread may have been facilitated by the limited availability of toilet facilities for the galley crew. This outbreak demonstrates how antibiotic-resistant strains can be introduced into the United States, where they can pose treatment problems. The continuing problem of foodborne gastrointestinal disease in settings such as cruise ships underscores the need for basic hygienic control for food handlers and food preparation areas. In addition, the availability of adequate working conditions for crew members, including appropriately furnished toilet facilities, may be important issues that must be addressed in order to decrease the frequency of diarrhea outbreaks aboard cruise ships.

Lim-Quizon M.C. et al. *Cholera in metropolitan Manila: foodborne transmission via street vendors.* Bull World Health Organ. 1994; 72(5) : 745-9.p Abstract: Reported are the results of an unmatched case-control study to determine the risk factors associated with acquisition of cholera in Manila. Cases were patients admitted to the San Lazaro Hospital between July and September 1989 and whose stools yielded Vibrio cholerae O1 on culture. Controls were patients admitted to the same hospital and who had no history of diarrhoea or of having taken antibiotics during the 3 days prior to admission. Of the 158 cases and 158 controls who had bought food from street vendors, cases were more likely to have bought the following items: pansit (rice noodles with shrimp, meat, and vegetables), mussel soup, spaghetti, fish balls, pig blood coagulated with vinegar, and salty brine shrimp with vegetables. Cases were also more likely to lack piped water at home. An unconditional logistic regression analysis indicated that only pansit (OR = 2.15, 95% CI = 1.32-3.51), mussel soup (OR = 2.29, 95% CI = 1.06-4.95), and the absence of piped water at home (OR = 2.70, 95% CI = 1.63-4.46) remained as risk factors. As control measures we recommend stricter implementation of the food sanitation code and the licensing of street food vendors.

Lin J.S. et al. *Development and use of polymerase chain reaction for the specific detection of Salmonella Typhimurium in stool and food samples.* J Food Prot. 1999; 62(10) : 1103-10.p Abstract: Salmonella Typhimurium is one of the most important Salmonella serovars that may cause foodborne disease and human salmonellosis infection. Detection of this organism in the clinical samples of persons with gastroenteritis and the food samples associated with such persons may allow us to trace the cause of disease. Because malic acid dehydrogenase, an enzyme of the citric acid cycle, is common to organisms, the gene (mdh) coding for this enzyme was selected for the design of Salmonella Typhimurium-specific polymerase chain reaction (PCR) primers. By comparison of the mdh gene sequences of Salmonella Typhimurium and other Salmonella serotypes and of some isolates of other genera, two oligonucleotides were designed and used as PCR primers for the specific detection of Salmonella Typhimurium. The molecular weight of the PCR product was 261 bp as expected. Salmonella serovars other than Salmonella Typhimurium and isolates of other genera in the Enterobacteriaceae that is closely related to Salmonella did not generate any false-positive results. When this primer pair was used for the detection of Salmonella Typhimurium cells artificially inoculated into human stool specimens and food samples, such as milk and raw chicken meat, levels as low as 10(0) CFU per 0.1 g of stool specimen or per ml of milk or food homogenate could be detected if an 8- to 12-h preculture step using combined lactose-tetrathionate broth was performed prior to the PCR.

Lindsay J.A. *Chronic sequelae of foodborne disease.* Emerg Infect Dis. 1997; 3(4) : 443-52.p Abstract: In the past decade the complexity of foodborne pathogens, as well as their adaptability and ability to cause acute illness, and in some cases chronic (secondary) complications, have been newly appreciated. This overview examines long-term consequences of foodborne infections and intoxications to emphasize the need for more research and education.

Lipp E.K. et al. *The role of seafood in foodborne diseases in the United States of America.* Rev Sci Tech. 1997; 16(2) : 620-40.p Abstract: In the United States of America, seafood ranked third on the list of products which caused foodborne disease between 1983 and 1992. Outbreaks connected with fish vectors were caused by scombroid, ciguatoxin, bacteria and unknown agents; in shellfish, unknown agents, paralytic shellfish poisoning, Vibrio spp. and other bacteria, followed by hepatitis A virus, were responsible for the outbreaks. At least ten genera of bacterial pathogens have been implicated in seafood-borne diseases. Over the past twenty-five years, bacterial pathogens associated with faecal contamination have represented only 4% of the shellfish-associated outbreaks, while naturally-occurring bacteria accounted for 20% of shellfish-related illnesses and 99% of the deaths. Most of these indigenous bacteria fall into the family Vibrionaceae which includes the genera Vibrio, Aeromonas and Plesiomonas. In general, Vibrio spp. are not associated with faecal contamination and therefore faecal indicators do not correlate with the presence of Vibrio. Viruses are the most significant cause of shellfish-associated disease: in New York State, for example, 33% and 62% of 196 outbreaks between 1981 and 1992 were caused by Norwalk virus and gastrointestinal viruses (small round structured viruses), respectively. In addition, several illnesses are a result of toxic algal blooms, the growth of naturally occurring bacteria and diatoms causing neurotoxic shellfish poisoning, paralytic shellfish poisoning, diarrhoetic shellfish poisoning, amnesic shellfish poisoning and ciguatera. Current estimates place the annual number of ciguatera cases at 20,000 world-wide. Scombroid poisoning is the most significant cause of illness associated with seafood. Scombrotoxin is of bacterial origin and halophilic Vibrio spp. causing high histamine levels are implicated as

the source. Scombroid poisoning is geographically diverse and many species have been implicated, namely: tuna, mahi-mahi, bluefish, sardines, mackerel, amberjack and abalone. Temperature abuse has been cited as a major cause of scombroid poisoning. For routine work, the use of faecal indicators to predict the relative level of faecal contamination should not be disposed of. However, the main source of seafood illness is due to species which are not predicted by these organisms. In order to protect public health, routine surveillance using new pathogen-specific techniques such as polymerase chain reaction should be used. This, in combination with risk assessment methods and hazard analysis and critical control points, will begin to address the need for improvement in the safety of seafood.

Loaharanu P. *Irradiation as a cold pasteurization process of food.* Vet Parasitol. 1996; 64(1-2) : 71-82.p Abstract: A number of emerging pathogenic microorganisms and parasites in food, the wide publicity of outbreaks of foodborne diseases and the increasing number of immuno-compromised population have resulted in a need to develop proper strategies and technologies to protect health of consumers. Regulations in most countries which are promulgated to ensure safety of foods, are not properly enforced to protect consumers' health especially with regard to food of animal origin. While regulations are in place and properly enforced for liquid foods such as milk or fruit juices, more solid foods especially those of animal origin, e.g. poultry, meat and seafood, which are often contaminated by pathogenic microorganisms and parasites, are not similarly regulated. The number of incidences of foodborne diseases can the subsequent economic impact to the society can be enormous. Recently, an increasing number of national and international organizations have recognised the use of irradiation as a method to ensure hygienic quality of more solid food of animal origin in the same manner as thermal pasteurization does for liquid foods. The effectiveness of irradiation as a cold pasteurization method to control foodborne disease caused by pathogenic microorganisms and parasites, especially in food to be consumed raw or partially processed, is established. Its role in overcoming trade barriers of food of animal origin based on the principle of the Agreement on the Application of Sanitary and Phytosanitary Measures, adopted during the GATT Uruguay Round will be discussed.

Loncarevic S. et al. *A case of foodborne listeriosis in Sweden.* Lett Appl Microbiol. 1997; 24(1) : 65-8.p Abstract: A 70-year-old woman fell seriously ill overnight with meningitis and was admitted to hospital. Cerebrospinal fluid culture yielded Listeria monocytogenes. One of the first problems in solving a human case of listeriosis suspected to be foodborne is to find the foods likely to have been transmitting L. monocytogenes. Two enrichment procedures and a direct plating procedure were used for isolation of the bacteria from different food items collected from the patient's refrigerator, local retail store and producer. Samples of vacuum-packed products of sliced pork brawn, sliced cooked medwurst and berliner wurst of the same brand harboured L. monocytogenes. Serotyping and restriction enzyme analysis (REA) with pulsed-field gel electrophoresis (PFGE) were used to characterize and compare 41 isolates, including the human strain. At least three clones were present in the foods investigated, and one of these was identical to the human clone. This clone was present in samples of medwurst from the patient's refrigerator and the local retail store. This is, to our knowledge, the first proven foodborne case of listeriosis reported in Sweden.

Lopes J.A. *Susceptibility of antibiotic-resistant and antibiotic-sensitive foodborne pathogens to acid anionic sanitizers.* J Food Prot. 1998; 61(10) : 1390-5.p Abstract: Acid anionic sanitizers for treatment of fruits and vegetables were prepared using ingredients generally recognized as safe by the U.S. Food and Drug Administration or anionic surfactants and organic acid food additives. They met the regulatory definition as sanitizers by showing bactericidal efficacy of 99.999% in 30 s against Staphylococcus aureus ATCC 6538 and Escherichia coli ATCC 11229. These sanitizers showed a broad spectrum of microbicidal activity against both gram-positive and gram-negative bacteria. Antibiotic-sensitive and resistant strains of Listeria monocytogenes and Salmonella typhimurium were equally susceptible to these sanitizers. The acid anionic sanitizers showed microbicidal efficacy equal to that of hypochlorite against Aeromonas hydrophila, E. coli O157:H7, L. monocytogenes, Pseudomonas aeruginosa, S. typhimurium, and S. aureus. Unlike most other sanitizers, these agents do not covalently react with organic components of food; unlike cationic agents, they do not leave residues. The acid anionic sanitizers are prepared using stable, biodegradable, and nontoxic ingredients. Rapid microbicidal activity and the ease of storage, transportation, and use make these sanitizers an attractive alternative to hypochlorite for sanitizing fruits and vegetables.

Lu P. et al. *Characterization of monoclonal antibodies for the rapid detection of foodborne campylobacters.* Int J Food Microbiol. 1997; 37(1) : 87-91.p Abstract: The specificity of 97 monoclonal antibodies (MAbs) to the Campylobacter jejuni Lior serogroup 6 reference strain was assessed using an indirect enzyme linked immunosorbent assay (ELISA). Four MAbs, M316, M337, M357 and M637, reacted with whole cells of the C. jejuni, C. coli and C. lari reference strains of the 20 most common Lior serogroups and 25 recent C. jejuni and C. coli isolates, and did not react with most of the 42 other Campylobacter and non-Campylobacter spp. tested. Immunoblot analysis revealed that MAbs M337 and M357 reacted with a protein component with molecular mass of approximately 62 kiloDaltons (kDa) while M316 and M637 reacted with protein components of approximately 92 and 31 kDa, respectively. The detection limit of M357 in an indirect ELISA was 10(5) colony forming units. These four highly specific MAbs may be useful reagents of an immunoassay for the rapid detection of thermophilic campylobacters in foods and clinical samples.

Lucht L. et al. *Recovery of foodborne microorganisms from potentially lethal radiation damage.* J Food Prot. 1998; 61(5) : 586-90.p Abstract: A two-stage recovery protocol was examined for microorganisms following gamma irradiation in phosphate buffer at 0 degrees C. In the first stage, survivors were recovered on basal yeast extract agar and held at various temperatures suboptimal for their growth for 20 h (resuscitation protocol). In the second stage the survivors were incubated for an additional 24 h, but in this case at their optimum temperature for growth. Controls consisted of survivors which were not subjected to the resuscitation protocol (direct incubation at their optimum growth temperature). The ratio of survivors enumerated with and without the resuscitation protocol (control) at each specified temperature was used to formulate a recovery factor(RF). An RF was determined for each treatment dose. Results of this study indicated that the number of Escherichia coli, Salmonella serotype typhimurium and Brochothrix thermosphacta survivors increased following a resuscitation protocol (RF > 2.0). Overall, optimum resuscitation temperatures ranged from 14 to 22 degrees C. The extent of recovery also appeared dose dependent, with larger treatment doses giving rise to a higher RF. S. serotype typhimurium irradiated at 1.5 kGy exhibited the highest RF, 161, when resuscitated at 22 degrees C. Listeria monocytogenes, Yersinia enterocolitica, Staphylococcus aureus, Aeromonas hydrophila and Saccharomyces cerevisiae exhibited an RF < 2.0 regardless of resuscitation temperature. Results of this study indicated that the use of suboptimal holding temperatures as part of a recovery protocol may have advantages, especially with respect to the enumeration of E. coli and salmonellae survivors in irradiated foods such as poultry.

Lucore L.A. et al. *Inactivation of Listeria monocytogenes Scott A on artificially contaminated frankfurters by high-pressure processing.* J Food Prot. 2000; 63(5) : 662-4.p Abstract: Vacuum-packaged frankfurters, inoculated with 24-h cultures of Listeria monocytogenes Scott A (approximately 10(9) CFU/ml) by injection into the packages, were held at pressures of 300, 500, and 700 MPa for up to 9 min. L. monocytogenes were washed from the surface of the frankfurter and plated onto brain heart infusion agar. During the time to achieve 300, 500, and 700 MPa (come-up time), L. monocytogenes populations decreased by 1, >3, and >5 logs, respectively. Additional inactivation of L. monocytogenes occurred while the samples were held at 300 and 500 MPa. A 5-log reduction in bacterial population was possible at all pressure treatments; however, pressurization at 700 MPa showed the fastest inactivation with L. monocytogenes reduced from 10(8) to 10(2) CFU/package during the come-up time. These results show that high-pressure processing may be a viable method for controlling foodborne pathogens in postprocessed, packaged frankfurters.

Lujan R. et al. *Plasmid profiles as an epidemiological marker for Salmonella enterica serotype Enteritidis foodborne outbreaks.* Microbiologia. 1990; 6(1) : 45-50.p Abstract: The incidence of enteritidis serotype of Salmonella enterica in salmonellae infections has steadily increased in Spain from 27.1% in 1982 up to 63.4% in 1987. Given this high incidence, we have studied the plasmid profiles of Enteritidis isolates to subclassify them. Different profiles were observed in 50 isolates. In 13 Enteritidis serotype outbreaks, up to 5 different plasmid profiles were found. Each outbreak correlated with a single plasmid profile except in one case where plasmids of two different profiles were observed in strains from the same outbreak.

Lund T. et al. *Characterisation of a non-haemolytic enterotoxin complex from Bacillus cereus isolated after a foodborne outbreak.* FEMS Microbiol Lett. 1996; 141(2-3) : 151-6.p Abstract: Three enterotoxic components have been isolated from a strain of Bacillus cereus which was involved in a large food poisoning outbreak in Norway in 1995. The components were purified by chromatography on three different columns. Three proteins of 39, 45 and 105 kDa, respectively, were found to be necessary for maximum cytotoxicity. The amino acid N-terminal sequences of the 39 and 45 kDa proteins were determined. The 45 kDa component was the same protein as the main antigen detected in the Bacillus Diarrhoeal Enterotoxin Visual Immunoassay (Tecra). The 39 kDa protein showed some similarity to the L1 protein of haemolysin BL from B. cereus. Furthermore, the three toxic components were all recognised by a polyclonal antiserum reported to detect enterotoxin from B. cereus. The proteins were different from the B- and L2-components of haemolysin BL, previously suggested to be a primary virulence factor, and had no detectable haemolytic activity.

Luthi T.M. et al. *Outbreaks of foodborne viral gastroenteritis in England and Wales: 1992 to 1994.* Commun Dis Rep CDR Rev. 1996; 6(10) : R131-6.p Abstract: Outbreaks of foodborne viral gastroenteritis in England and Wales from 1992 to 1994 have been analysed using data from the national surveillance scheme for general outbreaks of infectious intestinal disease. The cause was virologically confirmed for 389 (31%) of the 1280 outbreaks for which a minimum set of data were collected. Forty-seven of the 389 were attributed to foodborne transmission, 41 of which were caused by small round structured viruses (SRSV). An infected food handler was suspected to be a contributing factor in 14 and the consumption of oysters in eight of these 41 foodborne SRSV outbreaks. No seasonal pattern emerged. The highest incidences occurred in Wales, West Midlands, and South Western regional health authorities. The annual rate of outbreaks did not increase during the three year period (Chi square for linear trend 0.6; p = 0.4). Much remains to be discovered about the epidemiology of foodborne viruses, and outbreaks present an opportunity to enhance our knowledge. As molecular diagnostic techniques become routinely available, it is likely that the role of viruses in foodborne outbreaks will be increasingly recognised.

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MacDiarmid S.C. et al. *The potential risks to animal health from imported sheep and goat meat.* Rev Sci Tech. 1997; 16(1) : 45-56.p Abstract: Alerted by outbreaks of foot and mouth disease and the swine fevers which have been attributed to international trade in meat, regulators have tended to adopt conservative policies with respect to the importation of meat. However, for disease introduction to occur as a result of meat importation, a number of criteria must be satisfied. A qualitative assessment of the risks posed by sheep and goat meat leads to the conclusion that, with the possible exception of foot and mouth disease there is little likelihood that Office International des Epizooties List A or List B diseases would be spread through trade in adequately matured meat obtained from animals which have passed veterinary ante-mortem and post-mortem inspections.

MacGowan A.P. et al. *The occurrence and seasonal changes in the isolation of Listeria spp. in shop bought food stuffs, human faeces, sewage and soil from urban sources.* Int J Food Microbiol. 1994; 21(4) : 325-34.p Abstract: Eight hundred and twenty-two shop-bought food specimens, 136 soil and 692 faecal specimens were cultured for Listeria spp. in a regular, year round survey. 19.7% (162/822) of the foods, 93.9% (108/115) of the sewage, 14.7% (20/136) soils and 1% (7/692) of faeces yielded Listeria spp. with 10.5% foods, 60.0% sewage, 0.7% soils and 0.6% faeces containing L. monocytogenes. No seasonal variation was noted in isolates from either sewage or foods, with L. monocytogenes and L. innocua being the commonest species in both L. ivanovii when isolated from foods was strongly associated with mutton. Poultry was most likely to contain L. monocytogenes (65.6%, 21/32) and in the greatest numbers. A high percentage of beef (34.6%, 9/26), lamb (40%, 8/20), pork (28.1%, 9/32) and sausages (34.7%, 8/23) also contained L. monocytogenes. L. monocytogenes was rarely isolated from pate (1/40) or soft cheeses (1/251), both of which have been involved with foodborne listeriosis outbreak in the UK. Listeria spp. were commonest in faeces and soils in July to September but the predominant species isolated were different with L. monocytogenes and L. innocua the commonest from faeces and L. ivanovii and L. seeligeri the most common from soil.

Maciorowski K.G. et al. *Consumer poultry meat handling and safety education in three Texas cities.* Poult Sci. 1999; 78(6) : 833-40.p Abstract: Shifting demographics, increased poultry consumption and a general ignorance concerning food safety measures provide the potential for increased foodborne illness. In order to determine where food safety educational efforts would be most effective and the needed content of the messages, a survey addressing poultry preparation, storage and thawing methods, and sources of food safety education was constructed and distributed in supermarkets in three Texas urban centers. Between 60 and 67% of consumers prepared poultry once or twice per week. A majority of Hispanics (57%), minors (79%) and uneducated (55%) respondents thaw poultry outside of the refrigerator, either on a counter, in a microwave, or in a sink of water. A majority of Caucasians receive food safety information from either magazines (52%) or television (60%), whereas minors receive education mainly from the educational system (57%) or family (71%). Through increased education in these areas, good food safety habits may be increased in those target groups, especially the next generation of consumers.

Magras C. et al. *[The dangers for public health connected to the consumption of horse meat]*. Rev Sci Tech. 1997; 16(2) : 554-63.p Abstract: After an outline of the ways in which horse meat is produced and consumed, the authors review specific and general risks associated with this product, and methods for the control and prevention of these risks are given. With regard to biological hazards transmitted by horse meat, the relevant zoonoses are considered, followed by a discussion of the two principal agents responsible for foodborne disease in human beings: Salmonella and Trichinella. Among chemical hazards, the toxic effects of cadmium are prominent. Although these hazards can be identified, the actual risks to human health are difficult to estimate, because of the paucity of scientific data.

Maguire H. et al. *Hospital outbreak of Salmonella virchow possibly associated with a food handler.* J Hosp Infect. 2000; 44(4) : 261-6.p Abstract: A foodborne outbreak of salmonella infection at a private hospital in London in 1994 was found to be associated with eating turkey sandwiches prepared by a food handler. One patient, nine staff, and a foodhandler's baby were confirmed to have Salmonella enterica serotype virchow, phage type 26 infection. The attack rate was estimated to be 5% among the approximately 200 patients and staff at risk. A food handler reportedly became ill days after, but her baby days before, the first hospital case. Although it appeared to be a single outbreak, antibiogram analysis, supplemented by plasmid profile typing, demonstrated that there were two strains of S. virchow involved, one with resistance to sulphonamides and trimethoprim and a second sensitive to these antimicrobial drugs. Mother and child had different strains. The investigation demonstrated the importance of full phenotypic characterization of putative outbreak strains including antimicrobial susceptibility testing.Outbreaks of foodborne infection in hospitals are preventable and are associated with high attack rates and disruption of services. There is a need for good infection control policies and training of all staff involved in patient care as well as in catering services. Consultants in Communicable Disease (CCDCs) should include private hospitals in their outbreak control plans. Good working relations between Infection Control Doctors (ICDs) in the private health sector and their local CCDCs are important if outbreaks are to be properly investigated. Copyright 2000 The Hospital Infection Society.

Mahon B.E. et al. *An international outbreak of Salmonella infections caused by alfalfa sprouts grown from contaminated seeds.* J Infect Dis. 1997; 175(4) : 876-82.p Abstract: An outbreak of Salmonella serotype stanley infections occurred in the United States and Finland in 1995. The outbreak was investigated through case-control studies in Arizona, Michigan, and Finland; by isolate subtyping; and by tracing and culturing of the implicated food. Alfalfa sprout consumption was the only exposure associated with S. stanley infections in Arizona (matched odds ratio [MOR] = 11.1; 95% confidence interval [CI], 1.4-513), Michigan (MOR = 5.5; CI, 1.6-23), and Finland (MOR undefined; CI, 4.9-infinity). US and Finnish patient isolates were a unique outbreak strain distinct from S. stanley isolates not linked to the outbreak. Alfalfa sprouts eaten by patients in 6 US states and Finland were traced to seed shipped by a Dutch shipper. Thus, it was concluded that alfalfa sprouts grown from contaminated seed caused an international outbreak of > or =242 S. stanley infections in > or =17 US states and Finland. This outbreak illustrates a new mechanism through which contamination of fresh produce can cause large, widely dispersed outbreaks.

Mahon B.E. et al. *Consequences in Georgia of a nationwide outbreak of Salmonella infections: what you don't know might hurt you.* Am J Public Health. 1999; 89(1) : 31-5.p Abstract: OBJECTIVES: This study assessed the impact in Georgia of a nationwide salmonellosis outbreak caused by ice cream products and the effectiveness of the subsequent warning against eating the implicated products. METHODS: A telephone survey of 250 randomly selected Georgia customers of the ice cream producer was conducted 13 to 17 days after the warning. RESULTS: Respondents from 179 households representing 628 persons were interviewed. The median date of first hearing the warning was 5 days after it was issued, and 16 respondents (9%) had not heard it. Among those who had heard the warning, 42 (26%) did not initially believe the products were unsafe. In 22 (31%) of the 72 households that had the implicated ice cream when the respondent heard the warning, someone subsequently ate the ice cream. Diarrhea was reported in 26% (121/463) of persons who had eaten the products but in only 5% (8/152) who had not (odds ratio [controlling for household clustering] = 3.8; 95% confidence interval = 2.0, 7.5). We estimate this outbreak caused 11,000 cases of diarrhea in Georgia, 1760 (16%) with exposure after the warning. CONCLUSIONS: A large outbreak occurred in Georgia, much of which might have been prevented by a more timely and convincing warning.

Mahon C.R. *Foodborne illness: is the public at risk?* Clin Lab Sci. 1998; 11(5) : 291-7.p Abstract: Millions of people suffer from foodborne illness yearly. While most experience self-limiting events, others suffer from more serious forms of the disease. During the past 20 years, the epidemiology of foodborne diseases has evolved as new pathogens emerged. Factors that have been attributed to the increased risk for foodborne illness include new food vehicles of transmission, consumer lifestyles, and eating trends. Low-dose contamination of commercially prepared food items has caused widespread international outbreaks. In addition, increased antimicrobial resistance among foodborne pathogens is being recognized. The food industry and regulatory agencies collaborate in developing effective surveillance and investigative methods to reduce the risk for foodborne illness.

Majkowski J. *Strategies for rapid response to emerging foodborne microbial hazards.* Emerg Infect Dis. 1997; 3(4) : 551-4.p Abstract: The foodborne outbreak paradigm has shifted. In the past, an outbreak affected a small local population, had a high attack rate, and involved locally prepared food products with limited distribution. Now outbreaks involve larger populations and may be multistate and even international; in many the pathogenic organism has a low infective dose and sometimes is never isolated from the food product. Delay in identifying the causative agent can allow the outbreak to spread, increasing the number of cases. Emergency intervention should be aimed at controlling the outbreak, stopping exposure, and perhaps more importantly, preventing future outbreaks. Using epidemiologic data and investigative techniques may be the answer. Even with clear statistical associations to a contaminated food, one must ensure that the implicated organism could logically and biologically have been responsible for the outbreak.

Manandhar R. et al. *Isolation of verotoxigenic Escherichia coli from the Tasmanian environment.* Comp Immunol Microbiol Infect Dis. 1997; 20(3) : 271-9.p Abstract: Growing concerns on the emergence of verotoxin producing Escherichia coli (VTEC) in Australia have focused our attention on the possible sources of VTEC within the island state of Tasmania. An analysis of 156 food samples and 194 water samples obtained from various areas revealed evidence of eight possible sources. Six strains, with serotypes Ont:Hnt, O86:H-, O88:H-, O126:H21 and O134:H-, were isolated from water samples. Two VTEC of serotypes Ont:H8, 081:H- were isolated from raw meat samples. The waterborne isolates produced verocytotoxin. VT1, while both foodborne isolates were strong producers of VT2. Three VTEC isolates produced haemolysins, only one produced enterohaemolysin (EntHly) and the remaining were reported with alpha-haemolysin (alpha-Hly) activity. An important feature in the majority of isolates from water was their lack of ability to ferment lactose these isolates are routinely overlooked in public health laboratories.

Mandrell R.E. et al. *Novel detection techniques for human pathogens that contaminate poultry.* Curr Opin Biotechnol. 1999; 10(3) : 273-8.p Abstract: Poultry products are presumed to be a major contributor to human foodborne illness due to their high frequency of contamination with pathogens Salmonella spp. and Campylobacter spp. This has stimulated the development of more sensitive and rapid methods for identifying pathogens present in poultry. These new methods include immunomagnetic separation of

pathogen, PCR amplification of pathogen-specific sequences, pathogen-specific DNA and RNA probes, and identification of pathogen-specific ions by mass spectrometry.

Marsh R.F. et al. *Epidemiologic and experimental studies on transmissible mink encephalopathy.* Dev Biol Stand. 1993; 80 : 111-8.p Abstract: Transmissible mink encephalopathy (TME) is a rare foodborne disease of ranch-raised mink produced by an as yet unidentified contaminated feed ingredient. Because of the clinicopathologic similarities to scrapie and the indistinguishable physicochemical properties of their transmissible agents, it was initially assumed that TME was caused by feeding mink scrapie-infected sheep. However, subsequent studies testing the oral susceptibility of mink to scrapie were unsuccessful. Epidemiologic investigations of individual incidents of TME have not identified an association between the occurrence of disease and the feeding of any particular ingredient. However, there are two incidents in which the rancher was confident that sheep were not fed. The most recent of these was in Stetsonville, Wisconsin in 1985 where the meat portion of the diet was composed almost exclusively of downer dairy cows. To examine the possibility that cattle may have been the source of infection on the Stetsonville ranch, mink brain was experimentally inoculated intracerebrally into two Holstein steers. Both of these animals developed fatal spongiform encephalopathies 18 and 19 months after inoculation. These findings are compatible with the Stetsonville incident of TME being caused by feeding mink infected cattle tissue and they suggest the presence of an unrecognized BSE-like disease in the United States. Further experimental studies on the Stetsonville source of TME have identified two distinct strains of the transmissible agent in Syrian hamsters. These strains vary in length of incubation period, clinical signs, endstage brain infectivity titre, and pathogenicity for mink.(ABSTRACT TRUNCATED AT 250 WORDS).

Maslanka S.E. et al. *Molecular subtyping of Clostridium perfringens by pulsed-field gel electrophoresis to facilitate food-borne-disease outbreak investigations.* J Clin Microbiol. 1999; 37(7) : 2209-14.p Abstract: Clostridium perfringens is a common cause of food-borne illness. The illness is characterized by profuse diarrhea and acute abdominal pain. Since the illness is usually self-limiting, many cases are undiagnosed and/or not reported. Investigations are often pursued after an outbreak involving large numbers of people in institutions, at restaurants, or at catered meals. Serotyping has been used in the past to assist epidemiologic investigations of C. perfringens outbreaks. However, serotyping reagents are not widely available, and many isolates are often untypeable with existing reagents. We developed a pulsed-field gel electrophoresis (PFGE) method for molecular subtyping of C. perfringens isolates to aid in epidemiologic investigations of food-borne outbreaks. Six restriction endonucleases (SmaI, ApaI, FspI, MluI, KspI, and XbaI) were evaluated with a select panel of C. perfringens strains. SmaI was chosen for further studies because it produced 11 to 13 well-distributed bands of 40 to approximately 1,100 kb which provided good discrimination between isolates. Seventeen distinct patterns were obtained with 62 isolates from seven outbreak investigations or control strains. In general, multiple isolates from a single individual had indistinguishable PFGE patterns. Epidemiologically unrelated isolates (outbreak or control strains) had unique patterns; isolates from different individuals within an outbreak had similar, if not identical, patterns. PFGE identifies clonal relationships of isolates which will assist epidemiologic investigations of food-borne-disease outbreaks caused by C. perfringens.

Matar G.M. et al. *Subtyping of Bacillus cereus by total cell protein patterns and arbitrary primer polymerase chain reaction.* Eur J Epidemiol. 1996; 12(3) : 309-14.p Abstract: Bacillus cereus is a ubiquitous sporeforming Gram-positive rod that is associated with foodborne outbreaks as well as several opportunistic infections. Inspite of the prevalence of B. cereus associated foodborne outbreaks, subtyping of the species using molecular typing assays was not attempted. In this study we have recovered 58 B. cereus isolates from natural and clinical sources and initially characterized them, along with a B. cereus strain (ATCC 14579) and B. thuringiensis natural isolate, by biotyping, antibiotic susceptibility testing, and SDS-PAGE of total cell proteins. Our data have shown the existence of 1 biotype, 3 anti-biograms and 22 (38%) total cell protein patterns among the 58 B. cereus isolates. B. thuringiensis had a different protein pattern. SDS-PAGE of total cell proteins data denote clonal heterogeneity within B. cereus. Protein pattern 4 (pp4) was the most predominant with 13 isolates of B. cereus showing this pattern. Eight out of the 13 isolates with pp4 and one B. cereus strain (ATCC 14579) were further subtyped by using the arbitrary primer polymerase chain reaction (AP-PCR) assay. Eight (88.8%) different PCR patterns out of the 9 B. cereus isolates were obtained. Patterns obtained by SDS-PAGE of total cell proteins and AP-PCR were reproducible. These results indicate that SDS-PAGE of total cell proteins allows the differentiation among species within Bacillus and of strains within B. cereus. The typability of the method was 100% and the simpson's discrimination index of diversity was 98%. The utility of SDS-PAGE of total cell proteins in a pilot epidemiologic study was assessed and results obtained demonstrate its typing potential. AP-PCR allows further subtyping of the species. Both methods if used in conjunction may be useful for further clinical and epidemiologic studies of the spectrum of diseases caused by B. cereus.

Mathias R.G. et al. *The evaluation of the effectiveness of routine restaurant inspections and education of food handlers: restaurant inspection survey.* Can J Public Health. 1994; 85 Suppl 1 : S61-6.p Abstract: To determine restaurant inspection and food handler education practices in Canada, a survey of 141 jurisdictions was conducted. The response rate was 100%. All jurisdictions inspected restaurants, but the frequency of routine inspection varied from none to six or more times per year.

The frequency of violations found on routine inspection was associated with foodborne illness. However, the frequency of inspection was not correlated with disease or with violations. Food handler education courses were mandatory in 32% of jurisdictions. Most courses were one to two days. No correlation was found between the numbers of individuals trained in the past year and violations or reported foodborne disease. This lack of reduction in reported foodborne illness may be due to the ecological nature of the survey or to the lack of effectiveness of food handler education or of routine restaurant inspections in reducing violations.

Matricardi P.M. et al. *Exposure to foodborne and orofecal microbes versus airborne viruses in relation to atopy and allergic asthma: epidemiological study.* BMJ. 2000; 320(7232) : 412-7.p Abstract: OBJECTIVE: To investigate if markers of exposure to foodborne and orofecal microbes versus airborne viruses are associated with atopy and respiratory allergies. DESIGN: Retrospective case-control study. PARTICIPANTS: 240 atopic cases and 240 non-atopic controls from a population sample of 1659 participants, all Italian male cadets aged 17-24. SETTING: Air force school in Caserta, Italy. MAIN OUTCOME MEASURES: Serology for Toxoplasma gondii, Helicobacter pylori, hepatitis A virus, measles, mumps, rubella, chickenpox, cytomegalovirus, and herpes simplex virus type 1; skin sensitisation and IgE antibodies to relevant airborne allergens; total IgE concentration; and diagnosis of allergic asthma or rhinitis. RESULTS: Compared with controls there was a lower prevalence of T gondii (26% v 18%, P=0.027), hepatitis A virus (30% v 16%, P=0.004), and H pylori (18% v 15%, P=0.325) in atopic participants. Adjusted odds ratios of atopy decreased with a gradient of exposure to H pylori, T gondii, and hepatitis A virus (none, odds ratio 1; one, 0. 70; two or three, 0.37; P for trend=0.000045) but not with cumulative exposure to the other viruses. Conversely, total IgE concentration was not independently associated with any infection. Allergic asthma was rare (1/245, 0.4%) and allergic rhinitis infrequent (16/245, 7%) among the participants (245/1659) exposed to at least two orofecal and foodborne infections (H pylori, T gondii, hepatitis A virus). CONCLUSION: Respiratory allergy is less frequent in people heavily exposed to orofecal and foodborne microbes. Hygiene and a westernised, semisterile diet may facilitate atopy by influencing the overall pattern of commensals and pathogens that stimulate the gut associated lymphoid tissue thus contributing to the epidemic of allergic asthma and rhinitis in developed countries.

Matyas Z. *The state of food hygiene and foodborne diseases: requirements for the future.* Ann Ist Super Sanita. 1992; 28(4) : 451-8.p Abstract: The current world situation of foodborne diseases is reviewed with an analysis of the factors responsible for their occurrence in both developed and developing countries. Strategies to solve the problems associated with food hygiene are also reviewed with special attention to the most recent approaches identified and worked out by the main institutions concerned. Specific suggestions are given for more effective planning and implementation of future global food hygiene programmes.

Mauskopf J.A. et al. *Estimating the value of avoiding morbidity and mortality from foodborne illnesses.* Risk Anal. 1991; 11(4) : 619-31.p Abstract: When people consume products violating the Food, Drug, and Cosmetic (FD&C) Act they may experience morbidity or mortality from foodborne illness. Some studies have used survey data to estimate the dollar value of avoiding a few illnesses, but surveys are expensive and the resulting estimates cannot easily be generalized to the wide variety of foodborne illnesses. We develop a method that uses published data to estimate the value of avoiding morbidity and mortality from foodborne illnesses using two metrics--quality-adjusted life-years and dollars. The method first describes the effects of different illnesses on the patient and then converts these descriptions into changes in time spent in different health states with different relative utility weights. We use these estimated changes to compute losses in quality-adjusted life-years. We demonstrate our method and derive estimates for the value of avoiding a future case of botulism, salmonellosis, chronic hepatitis, and bladder cancer. Researchers can use our method to compare the value of avoiding all illnesses caused by violations of the FD&C Act. More importantly, government officials can use our method to quickly and cost-effectively generate morbidity and mortality valuation estimates for any illness for policy purposes.

McClure P.J. et al. *Survival of Escherichia coli in foods.* Symp Ser Soc Appl Microbiol. 2000; (29) : 61S-70S.p Abstract: Studies describing the survival of Escherichia coli in foods, more often than not use the O157:H7 serovar as the target organism. Whilst E. coli O157:H7 is undoubtedly the predominant agent of concern for foodborne disease caused by enterohaemorrhagic E. coli (EHEC), a consequence of this concern is the commonly held view that this one serovar is 'atypical' in its response to stress conditions and therefore better able to survive adverse environments. Many of the studies published do not make comparisons with other E. coli (either commensal organisms or other pathogenic types) or other members of the Enterobacteriaceae, that would justify this view. Nevertheless, there has been a great deal of valuable data and information generated describing the fate of E. coli O157:H7 in a range of foods stored under various conditions. In many respects, the results of these studies are not surprising considering the survivability of other closely related pathogens, such as Shigella spp. This ability to survive in foods for long periods of time confirms the need for reliable control measures where contamination is possible or likely, e.g. proper handling and thorough cooking of beefburgers. The factors that may influence survival in different foods are described, with the intention of providing an insight in this area of food safety. Key considerations for carrying out survival studies are identified, with particular reference to methodologies used.

McDonald L.C. et al. *Vancomycin-resistant enterococci outside the health-care setting: prevalence, sources, and public health implications.* Emerg Infect Dis. 1997; 3(3) : 311-7.p Abstract: Although nosocomial acquisition and subsequent colonization of vancomycin-resistant enterococci (VRE), an emerging international threat to public health, has been emphasized in the United States, colonization among nonhospitalized persons has been infrequently documented. In contrast, in Europe, colonization appears to occur frequently in persons outside the health-care setting. An important factor associated with VRE in the community in Europe has been avoparcin, a glycopeptide antimicrobial drug used for years in many European nations at subtherapeutic doses as a growth promoter in food-producing animals. In Europe, evidence suggests that foodborne VRE may cause human colonization. Although avoparcin has never been approved for use in the United States, undetected community VRE transmission may be occurring at low levels. Further studies of community transmission of VRE in the United States are urgently needed. If transmission with VRE from unrecognized community sources can be identified and controlled, increased incidence of colonization and infection among hospitalized patients may be prevented.

McDonough P.L. et al. *Interpretations of antibody responses to Salmonella enterica serotype enteritidis gm flagellin in poultry flocks are enhanced by a kinetics-based enzyme-linked immunosorbent assay.* Clin Diagn Lab Immunol. 1998; 5(4) : 550-5.p Abstract: Many regulatory and diagnostic programs for the detection of Salmonella enterica serotype Enteritidis infection in commercial poultry flocks have relied on rapid Pullorum agglutination tests to screen birds because of the shared antigens of S. enterica Enteritidis and S. enterica Pullorum and Gallinarum; however, the use of the enzyme-linked immunosorbent assay (ELISA) format affords better analytical sensitivity than crude agglutination tests. In this study, we adapted our earlier conventional indirect ELISA, using gm flagellin as the antigen, to a kinetics-based, computer-controlled ELISA (KELA). The KELA was used to screen for flagellin antibody from three commercial flocks: (i) a large flock involved in a U.S. Department of Agriculture trace back from a human S. enterica Enteritidis foodborne outbreak (n = 3,209), (ii) a flock infected with the endemic S. enterica Enteritidis serotype but which also had multiple other Salmonella serotypes (n = 65), and (iii) an S. enterica Pullorum-infected flock (n = 12). The first flock (S. enterica Enteritidis prevalence of 2.45% based on culture) provided a field test of the KELA and allowed the calculation of diagnostic sensitivity (D-Sn) and diagnostic specificity (D-Sp). With a cutoff of 10 (used for screening flocks [i.e., high sensitivity]), the KELA has a D-Sn of 95.2% and a D-Sp of 18.5%; with a cutoff of 140 (used in confirmatory flock testing [i.e., high specificity]), the KELA has a D-Sn of 28.0% and a D-Sp of 99.1%. We found that with a cutoff of 60 (D-Sn = 63.1%; D-Sp = 91.6%), we could eliminate reactions in the KELA caused by other non-S. enterica Enteritidis salmonellae. The KELA was also compared to two commercial rapid Pullorum tests, the Solvay (D-Sn = 94.9%; D-Sp = 55.5%) and the Vineland (D-Sn = 62.0%; D-Sp = 75.3%).

McDowell R.M. et al. *Long-term sequelae to foodborne disease.* Rev Sci Tech. 1997; 16(2) : 337-41.p Abstract: Most of the concern about foodborne disease has been focused on the immediate effects of acute infection. Recent information has shown that many of these foodborne infections also have long-term sequelae with serious health effects and a significant economic impact. To increase the awareness of animal health professionals to these sequelae, the authors discuss two groups of sequelae which are strongly associated with preceding infection (reactive arthritides, including Reiter's syndrome, and the Guillain-Barre syndrome) as well as the possible association between Crohn's disease and Mycobacterium paratuberculosis. The discussion includes a description of the disease syndromes along with epidemiological and economic information. More reliable epidemiologial and economic data on chronic sequelae to foodborne disease will be needed for future evaluation of the cost-effectiveness of mitigation strategies to reduce the occurrence of foodborne pathogens.

McIntosh W.A. et al. *Perceptions of risks of eating undercooked meat and willingness to change cooking practices.* Appetite. 1994; 22(1) : 83-96.p Abstract: Knowledge and awareness of food safety issues relating to improperly cooked hamburger and willingness to change hamburger cooking practices were examined from a representative sample of 1004 adult Texans. Awareness of the danger of improperly cooked hamburger, knowledge of specific foodborne pathogens and knowledge of food safety practices had no effect on willingness to change behavior, but respondents who were better-educated, female and Hispanic and respondents who used newspapers/magazines or televisions were all more likely to report willingness to change their cooking practices.

McKay A.L. et al. *The effect of sodium chloride concentration and pH on the growth of Salmonella typhimurium colonies on solid medium.* J Appl Bacteriol. 1995; 79(4) : 353-9.p Abstract: The growth of Salmonella typhimurium colonies on a model food system (agar solidified culture medium) was followed. Colony radius, determined using computer image analysis (IA) techniques, and viable cell number per colony were measured as indices of colony growth, and the effect of [NaCl] (0.5-3.5% (w/v)) and pH (7.0-5.0) on colony growth at 30 degrees C was observed; colonies were point inoculated from serial dilutions. Colony growth (between 13 and 26 h after inoculation) was linear when expressed in terms of radius, and exponential when expressed in terms of viable cell number per colony. Overall, both increasing the [NaCl] and decreasing the pH had little effect on colony growth, other than to delay the onset of linear radial growth. Initial specific growth rate (mu) ranged from 0.73 to 0.87 h-1. Thin films of agar medium on microscope slides allowed the growth of microcolonies to be observed after just 4 h incubation. A

greater understanding of the growth kinetics of bacterial colonies, and the effects of environment on such data, may enable better control of foodborne bacterial pathogens, and consequently an improvement in food product safety.

McKillip J.L. *Prevalence and expression of enterotoxins in Bacillus cereus and other Bacillus spp., a literature review.* Antonie Van Leeuwenhoek. 2000; 77(4) : 393-9.p Abstract: Members of the Bacillus genus are ubiquitous soil microorganisms and are generally considered harmless contaminants. However, a few species are known toxin producers, including the foodborne pathogen, B. cereus. This species produces two distinct types of foodborne illness, the emetic (vomit-inducing) syndrome, associated with consumption of toxin in cooked rice dishes, and the diarrheal illness seen occasionally following consumption of contaminated meats, sauces, and certain dairy products. In the latter case, illness results from the production of enterotoxins by vegetative cells in the small intestine of the host. In dairy products, the occurrence of Bacillus spp. is inevitable, and the spore-forming ability of this organism allows it to easily survive pasteurization. Many strains have been shown to grow and produce enterotoxin in dairy products at refrigeration temperatures. Evaluation of toxin gene presence and toxin expression in Bacillus spp. other than B. cereus has not been thoroughly investigated. However, the presence of natural isolates of Bacillus spp. harboring one or more enterotoxin gene(s) and subsequent demonstration of conditions which may support toxin expression holds crucial importance in the food safety arena.

McKillip J.L. et al. *rRNA stability in heat-killed and UV-irradiated enterotoxigenic Staphylococcus aureus and Escherichia coli O157:H7.* Appl Environ Microbiol. 1998; 64(11) : 4264-8.p Abstract: Differentiation of viable cells from nonviable cells is of considerable importance in the development of methods to detect foodborne pathogens. To study the suitability of 16S rRNA as an indicator of cell viability in nucleic acid-based detection assays, we examined rRNA stability in two representative foodborne pathogens, Escherichia coli O157:H7 and enterotoxigenic Staphylococcus aureus, which were inactivated by extreme heat, moderate heat, and UV irradiation. Cell death under all conditions was confirmed by a failure to grow in brain heart infusion broth after incubation for 48 h at 37 degrees C. rRNA stability was monitored by a Northern blot analysis, and detection was evaluated by using reverse transcription (RT)-PCR performed with two primer sets (which produced 325- and 1, 400-bp amplicons). rRNA of neither pathogen was detected by Northern blot analysis and RT-PCR after cells were killed by autoclaving at 121 degrees C for 15 min. In contrast, intact rRNA of both pathogens were detected by Northern blotting and could be amplified by RT-PCR up to 48 h after cells were killed by heat treatment at 80 degrees C and UV irradiation at 254 nm. rRNA was a suitable target molecule for monitoring bacterial viability under extreme heat conditions, but the presence of rRNA was not correlated with viability following moderate heat inactivation or UV irradiation of cells.

McMeekin T.A. et al. *Quantitative microbiology: a basis for food safety.* Emerg Infect Dis. 1997; 3(4) : 541-9.p Abstract: Because microorganisms are easily dispersed, display physiologic diversity, and tolerate extreme conditions, they are ubiquitous and may contaminate and grow in many food products. The behavior of microbial populations in foods (growth, survival, or death) is determined by the properties of the food (e.g., water activity and pH) and the storage conditions (e.g., temperature, relative humidity, and atmosphere). The effect of these properties can be predicted by mathematical models derived from quantitative studies on microbial populations. Temperature abuse is a major factor contributing to foodborne disease; monitoring temperature history during food processing, distribution, and storage is a simple, effective means to reduce the incidence of food poisoning. Interpretation of temperature profiles by computer programs based on predictive models allows informed decisions on the shelf life and safety of foods. In- or on-package temperature indicators require further development to accurately predict microbial behavior. We suggest a basis for a "universal" temperature indicator. This article emphasizes the need to combine kinetic and probability approaches to modeling and suggests a method to define the bacterial growth/no growth interface. Advances in controlling foodborne pathogens depend on understanding the pathogens' physiologic responses to growth constraints, including constraints conferring increased survival capacity.

Mead G.C. *Prospects for 'competitive exclusion' treatment to control salmonellas and other foodborne pathogens in poultry.* Vet J. 2000; 159(2) : 111-23.p Abstract: In newly hatched chicks, the rapid establishment of an adult-type intestinal microflora, via the oral route, produces almost immediate resistance to colonization by any food poisoning salmonellas that gain access to the rearing environment. Exploitation of the 'competitive exclusion' (CE) effect is now an accepted part of the overall strategy by which poultry-associated salmonellas are being controlled in some countries.This review covers practical aspects of CE treatment and factors affecting efficacy in both laboratory-scale trials and field studies. It also considers possible applications in preventing colonization of poultry with Escherichia coli 0157 and Campylobacter jejuni. For the latter, evidence suggests that the 'protective' organisms are different from those involved in salmonella control. Copyright 2000 Harcourt Publishers Ltd.

Mead P.S. et al. *Risk factors for sporadic infection with Escherichia coli O157:H7.* Arch Intern Med. 1997; 157(2) : 204-8.p Abstract: BACKGROUND: Little is known about risk factors for sporadic infection with Escherichia coli O157:H7. In response to a sharp increase in reported cases in New Jersey during July 1994, we conducted a case-control study to identify principal sources of infection

and contributing practices. METHODS: Standardized questionnaires were used to evaluate (1) potential exposures of case patients and matched controls and (2) knowledge, attitudes, and practices of food preparers in case and control households. Patient isolates were subtyped by pulsed-field gel electrophoresis. RESULTS: Patients with E coli O157:H7 infection (N = 23; median age, 9 years; 55% female) were more likely than healthy controls to have eaten a hamburger in the week preceding illness (matched odds ratio, undefined; P < .001); 80% of the hamburgers eaten by ill persons were prepared at home. Food preparers in case households were less likely than those in control households to report washing their hands (odds ratio, 8.5; P < .005) and work surfaces (odds ratio, 10.5; P < .05) after handling raw ground beef. Pulsed-field gel electrophoresis yielded 17 unique subtypes among the 23 patient isolates, indicating multiple sources of infection. CONCLUSIONS: Hamburgers prepared at home are an important source of sporadic E coli O157:H7 infections. We estimate that adequate hand washing by food preparers could have prevented 34% of E coli O157:H7 infections in the study population.

Mead P.S. et al. *Escherichia coli O157:H7.* Lancet. 1998; 352(9135) : 1207-12.p Abstract: Escherichia coli O157 was first identified as a human pathogen in 1982. One of several Shiga toxin-producing serotypes known to cause human illness, the organism probably evolved through horizontal acquisition of genes for Shiga toxins and other virulence factors. E. coli O157 is found regularly in the faeces of healthy cattle, and is transmitted to humans through contaminated food, water, and direct contact with infected people or animals. Human infection is associated with a wide range of clinical illness, including asymptomatic shedding, non-bloody diarrhoea, haemorrhagic colitis, haemolytic uraemic syndrome, and death. Since laboratory practices vary, physicians need to know whether laboratories in their area routinely test for E. coli O157 in stool specimens. Treatment with antimicrobial agents remains controversial: some studies suggest that treatment may precipitate haemolytic uraemic syndrome, and other studies suggest no effect or even a protective effect. Physicians can help to prevent E. coli O157 infections by counselling patients about the hazards of consuming undercooked ground meat or unpasteurised milk products and juices, and about the importance of handwashing to prevent the spread of diarrhoeal illness, and by informing public-health authorities when they see unusual numbers of cases of bloody diarrhoea or haemolytic uraemic syndrome.

Mead P.S. et al. *Food-related illness and death in the United States.* Emerg Infect Dis. 1999; 5(5) : 607-25.p Abstract: To better quantify the impact of foodborne diseases on health in the United States, we compiled and analyzed information from multiple surveillance systems and other sources. We estimate that foodborne diseases cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the United States each year. Known pathogens account for an estimated 14 million illnesses, 60, 000 hospitalizations, and 1,800 deaths. Three pathogens, Salmonella, Listeria, and Toxoplasma, are responsible for 1,500 deaths each year, more than 75% of those caused by known pathogens, while unknown agents account for the remaining 62 million illnesses, 265,000 hospitalizations, and 3,200 deaths. Overall, foodborne diseases appear to cause more illnesses but fewer deaths than previously estimated.

Meehan P.J. et al. *A foodborne outbreak of gastroenteritis involving two different pathogens.* Am J Epidemiol. 1992; 136(5) : 611-6.p Abstract: On the evening of October 10, 1990, many of the 474 inmates of a state prison in Florida began to experience symptoms of gastroenteritis. An investigation included interviews with inmates, evaluation of the kitchen and food-handling practices, cultures of leftover food, stool cultures, and cultures from the nares and skin lesions of food handlers. Of the 331 inmates interviewed, 215 (65%) had diarrhea, vomiting, or both. The median incubation period was 5 hours (range, 1-41 hours). Cases with onset of illness 8 or more hours after the evening meal were more likely than those with earlier onset to have had only diarrhea without vomiting ($p < 0.001$). Eating turkey at the evening meal on October 10 was associated with risk of illness (relative risk = 4.8, 95% confidence interval 1.7-13.7). Cases who became ill within 8 hours of the evening meal and those who became ill later were both more likely to have eaten turkey than those who did not become ill ($p < 0.001$ and $p < 0.007$, respectively). Salmonella infantis and enterotoxin-producing Staphylococcus aureus were both isolated from samples of leftover turkey, and S. infantis was isolated from 18 of 20 stool specimens. Cultures of the anterior nares and skin lesions of food handlers grew S. aureus, but phage typing failed to link these strains to the outbreak. Improper food-handling practices contributed to the development of this outbreak. This report highlights the importance of recognizing multiple-organism outbreaks, since the authors' recommendations for prevention of more cases depended upon knowing the risks associated with the distinct organisms and the possible sources of contamination.

Meer R.R. et al. *Immunochemical detection methods for Salmonella spp., Escherichia coli O157:H7, and Listeria monocytogenes in foods.* Rev Environ Contam Toxicol. 1995; 142 : 1-12.p Abstract: Immunochemical assays should prove to be a significant improvement over standard culture methods for the detection of foodborne pathogens. These techniques take advantage of the specificity and sensitivity of the antibody/antigen reaction for analyte detection. ELISA is the most useful form of immunochemical method for the detection of foodborne pathogens in the food-processing setting, based on their simplicity and ability to analyze large numbers of samples at a time. Concerns with immunochemical techniques include problems with cross-reactivity and difficulties obtaining species specific assays. Also, most immunochemical methods continue to require an enrichment technique; however, subsequent identification is quite rapid when compared with standard culture

methods, therefore allowing for the quicker release of negative products.

Meyer H. *[Animals as sources of infections in humans--salmonellosis]*. DTW Dtsch Tierarztl Wochenschr. 1999; 106(8) : 344-51.p Abstract: Foodborne infections/intoxications of men including salmonelloses increased as a whole in the last years. Some reasons for this development are discussed. From the 2,500 Salmonella serovars known at present only 10 to 15 are of epidemic importance, in the first place S. Typhimurium and S. Enteritidis. Mainly salmonella-contaminated foodstuffs from animals are sources of Salmonella infections in men. In this connection raw eggs and raw egg-containing food, as well as raw meat and meat products are of prime importance. Especially endangered are humans whose mechanisms of infectious defence are not fully developed (infants, young children) or are impaired to some extent (elderly people, immunocompromised persons). Salmonellosis control has to be carried out as a concerted action along the whole food chain, starting at animal farms and continuing with adequate methods at each stage of food production and processing, in trade, in restaurants and canteens up to private households. In connection with the health protection of consumers hygienic education of staff handling foodstuffs, as well as information of consumers are very important. Despite some deficiencies our knowledge is sufficient to work effectively in practice to improve the situation.

Millard P.S. et al. *An outbreak of cryptosporidiosis from fresh-pressed apple cider*. JAMA. 1994; 272(20) : 1592-6.p Abstract: BACKGROUND--Recent waterborne outbreaks have established Cryptosporidium as an emerging enteric pathogen, but foodborne transmission has rarely been reported. In October 1993, an outbreak of cryptosporidiosis occurred among students and staff attending a 1-day school agricultural fair in central Maine. DESIGN--Environmental/laboratory investigation and cohort study. PARTICIPANTS--Attendees of the fair and their household members. MAIN OUTCOME MEASURES--Clinical or laboratory-confirmed cryptosporidiosis. Clinical cryptosporidiosis was defined as 3 days of either diarrhea (three loose stools in a 24-hour period) or vomiting. RESULTS--Surveys were completed for 611 (81%) of the estimated 759 fair attendees. Among attendees who completed the survey, there were 160 (26%) primary cases. Cryptosporidium oocysts were detected in the stools of 50 (89%) of 56 primary and secondary case patients tested. The median incubation period was 6 days (range, 10 hours to 13 days); the median duration of illness was 6 days (range, 1 to 16 days). Eighty-four percent of primary case patients had diarrhea and 82% had vomiting. Persons drinking apple cider that was hand pressed in the afternoon were at increased risk for cryptosporidiosis (154 [54%] of 284 exposed vs six [2%] of 292 unexposed; relative risk, 26; 95% confidence interval, 12 to 59). Cryptosporidium oocysts were detected in the apple cider, on the cider press, and in the stool specimen of a calf on the farm that supplied the apples. The secondary household transmission rate was 15% (53/353). CONCLUSIONS--This is the first large cryptosporidiosis outbreak in which foodborne transmission has been documented. It underscores the need for agricultural producers to take measures to avoid contamination of foodstuffs with infectious agents common to the farm environment.

Mintz E.D. et al. *A rapid public health response to a cryptic outbreak of cholera in Hawaii*. Am J Public Health. 1994; 84(12) : 1988-91.p Abstract: In November 1991, toxigenic Vibrio cholerae O1 infection was confirmed in two unrelated persons in Hawaii. Cholera had not been acquired in Hawaii since 1895. To determine the source and extent of V cholerae O1 infections in Hawaii, both patients were interviewed, suspect food sources were investigated, and surveillance of physicians, laboratories, hospitals, and sewage treatment plants was instituted. One patient's husband had serologic titers consistent with recent V cholerae O1 infection; no other cases were confirmed and V cholerae O1 was not recovered from active surveillance of laboratories or sewage treatment plants. The investigation demonstrated that the outbreak had affected few persons and had ended.

Mintz E.D. et al. *Foodborne giardiasis in a corporate office setting*. J Infect Dis. 1993; 167(1) : 250-3.p Abstract: Giardiasis is the most commonly reported intestinal protozoal infection worldwide, but its relatively long incubation period and often insidious onset make detection of common-source outbreaks difficult. Few well-documented foodborne outbreaks of giardiasis have been reported. In November 1990, such an outbreak among insurance company employees resulted in 18 laboratory-confirmed and 9 suspected cases of giardiasis. A case-control study of 26 ill and 162 well employees implicated raw sliced vegetables served in the employee cafeteria and prepared by a food handler infected with Giardia lamblia as the probable vehicle (odds ratio, 5.1; 95% confidence interval, 1.4-22.7). This outbreak illustrates the potential for transmission of Giardia organisms to occur in commercial establishments through a frequently served food item.

Mintz E.D. et al. *An outbreak of Brainerd diarrhea among travelers to the Galapagos Islands*. J Infect Dis. 1998; 177(4) : 1041-5.p Abstract: In 1992, an outbreak of chronic diarrhea occurred among passengers on a cruise ship visiting the Galapagos Islands, Ecuador. Passengers (548) were surveyed, and stool and biopsy specimens from a sample who reported chronic diarrhea were examined. On completed questionnaires, returned by 394 passengers (72%), 58 (15%) reported having chronic diarrhea associated with urgency (84%), weight loss (77%), fatigue (71%), and fecal incontinence (62%). Illness began 11 days (median) after boarding the ship and lasted 7 to >42 months. Macroscopic and histologic abnormalities of the colon were common, but extensive laboratory examination revealed no etiologic agent. No one responded to antimicrobial therapy. Patients were more likely than well

passengers to have drunk the ship's unbottled water or ice before onset of illness and to have eaten raw sliced fruits and vegetables washed in unbottled water. Water handling and chlorination on the ship were deficient. Outbreaks of a similar illness, Brainerd diarrhea, have been reported in the United States. Although its etiology remains unknown, Brainerd diarrhea may also occur among travelers.

Mishu B. et al. *Foodborne hepatitis A: evidence that microwaving reduces risk?* J Infect Dis. 1990; 162(3) : 655-8.p Abstract: During July 1988, 68 persons in Chattanooga, Tennessee, developed serologically confirmed hepatitis A. Between 15 June and 3 July, 93% of case-patients ate at a specific restaurant compared with only 3% of the local community. An intravenous drug user who worked as a cook was identified as the source. A case-control study was done to identify the vehicle of transmission. Case-patients were more likely than controls to have eaten hamburger buns and pickles, the only foods routinely handled after cooking. Of the restaurant patrons included in the study, 12 microwaved their food before consumption; none developed clinical illness despite eating large amounts of food handled after cooking. Sandwiches that were not microwaved were significantly associated with illness (odds ratio = 9.6; P less than .02). This epidemiologic evidence suggests that microwaves inactivate hepatitis A virus in food.

Miyagishima K. et al. *Food safety in international trade.* World Health Forum. 1998; 19(4) : 407-11.p Abstract: International approaches are indispensable in the management of foodborne risks to health. The contributions made by WHO and the World Trade Organization to achieving food safety are discussed below, and particular reference is made to the Agreement on the Application of Sanitary and Phytosanitary Measures and to the work of the Codex Alimentarius Commission.

Modi K.D. et al. *Sensitivity of nisin-resistant Listeria monocytogenes to heat and the synergistic action of heat and nisin.* Lett Appl Microbiol. 2000; 30(3) : 249-53.p Abstract: Nisin, a bacteriocin produced by some strains of Lactococcus lactis, acts against foodborne pathogen Listeria monocytogenes. A single exposure of cells to nisin can generate nisin-resistant (Nisr) mutants, which may compromise the use of nisin in the food industry. The objective of this research was to compare the heat resistance of Nisr and wild type (WT) Listeria monocytogenes. The synergistic effect of heat-treatment (55 degrees C) and nisin (500 IU ml-1) on the Nisr cells and the WT L. monocytogenes Scott A was also studied. When the cells were grown in the absence of nisin, there was no significant (alpha = 0.05) difference in heat resistance between WT and Nisr cells of L. monocytogenes at 55, 60 and 65 degrees C. However, when the Nisr cells were grown in the presence of nisin, they were more sensitive to heat at 55 degrees C than the WT cells. The D-values at 55 degrees C were 2.88 and 2.77 min for Nisr ATCC 700301 and ATCC 700302, respectively, which was significantly (alpha = 0.05) lower than the D-value for WT, 3.72 min. When Nisr cells were subjected to a combined treatment of heat and nisin, there was approximately a four log reduction during the first 7 min of treatment.

Moe G. *Enteral feeding and infection in the immunocompromised patient.* Nutr Clin Pract. 1991; 6(2) : 55-64.p Abstract: Evidence is accumulating that immunocompromised individuals are at an increased risk of infection from foodborne pathogens including Campylobacter jejuni, Listeria monocytogenes, Salmonella spp. Normal bacterial flora and contaminants of foods and enteral feeds can also result in nosocomial infection in susceptible individuals. Safe food handling, low-microbial diets, and measures to reduce bacterial contamination of enteral foods can reduce exposure to potential pathogens in the food supply.

Molina-Gamboa J.D. et al. *Salmonella gastroenteritis outbreak among workers from a tertiary care hospital in Mexico City.* Rev Invest Clin. 1997; 49(5) : 349-53.p Abstract: OBJECTIVE: To describe an outbreak of Salmonella gastroenteritis among employees of the National Institute of Nutrition (INNSZ) of Mexico City during July, 1994. METHODS: Employees who developed diarrhea or fever associated with gastrointestinal symptoms starting on July 14th were included for study as well as 50 healthy controls. A questionnaire was applied to all, and they also provided a stool sample, along with other 80 asymptomatic people (included the kitchen workers) in whom only stool culture was done. RESULTS: Ninety-seven employees that ate regularly at the Hospital's cafeteria were affected by the outbreak, and 67 of them (69%) could be evaluated. Most of them were nurses (34%), and handymen (27%). Most common symptoms were abdominal pain (97%), diarrhea (95%), nausea (91%), and fever (89%). Cultures from suspicious food items were all negative, but stool cultures from 10/70 cases were positive for Salmonella enteritidis vs. 0/133 in the controls. The ten S. enteritidis isolates resulted identical either by serotyping and by rapid amplified polymorphic DNA (RAPD) analysis. Cultures from all kitchen employees were negative for S. enteritidis. Breakfast meal on July 14th was associated with the development of gastroenteritis (61/67 cases vs 26/50 controls, $p < 0.001$), and particularly with an egg-covered meat plate (61/62 vs 13/26 controls, $p < 0.0001$). CONCLUSIONS: This outbreak was probably caused by eggs contaminated with Salmonella, since no one of the kitchen personnel was found to be an asymptomatic carrier, and the implicated recipe allows for inappropriate cooking. Recommendations to improve cooking procedures must be added to the usual regulations to diminish the frequency of foodborne disease outbreaks in hospitals.

Molla B. et al. *Antibiotic resistance pattern of foodborne Salmonella isolates in Addis Ababa (Ethiopia).* Berl Munch Tierarztl Wochenschr. 1999; 112(2) : 41-3.p Abstract: A total of 39 Salmonella cultures isolated from raw minced beef and chicken (gizzard, liver, and heart) samples in

Addis Ababa were examined for susceptibility to a group of 10 selected antimicrobials. 34 isolates (87.2%) were resistant to one or more antibiotics. The antibiotics to which isolated Salmonella strains were most often fully resistant included nitrofurantoin (48.7%), furazolidone (48.7%) and streptomycin (46.2%). Only 4 antimicrobials (gentamycin, kanamycin, rifampicin and sulphamethoxazole-trimethoprim) were effective against all Salmonella isolates with the exception of 2 which were intermediate in resistance to kanamycin (1) and sulphamethoxazole-trimethoprim (1). 77.8% of the S. Enteritidis strains showed multiple resistance to up to four antibiotics followed by S. Typhimurium (60.0%) and S. Dublin (33.3%). The high level of antibiotic resistance of foodborne Salmonella isolates in the study area is an indication of indiscriminate and continuous use of subtherapeutic doses of antibiotics in animals.

Monge R. et al. *[Presence of various pathogenic microorganisms in fresh vegetables in Costa Rica].* Arch Latinoam Nutr. 1996; 46(4) : 292-4.p Abstract: This study reports the occurrence of some pathogenic microorganisms in vegetable consumed on a daily basis by Costa Ricans. Cryptosporidium sp. oocysts were found in 5.2% (4/80) of cilantro leaves, in 8.7% (7/80) of cilantro roots and 2.5% of lettuce samples. A 1.2% (1/80) incidence was found in other vegetables samples (carrot, cucumber, radish and tomatoe). Oocysts of this parasite were absent in cabbage. Giardia intestinalis was only detected in 5.2% (4/80) of cilantro leaves and in 2.5% (2/ 80) of cilantro roots. Entamoeba histolytica cysts were found in 6.2% (5/80) of cilantro leaves, in 2.5% (2/80) cilantro roots, in 3.8% (3/80) lettuce and in 2.5% (2/80) radish samples. At least a 2% incidence of this amoeba was found in other vegetable samples (carrot, cucumber, cabbage and tomatoe). Listeria monocytogenes was isolated in 20% (10/50) of the samples of cabbage salad. Hepatitis A virus and Rotavirus were evidenciated in three of the lettuce pooles, suggesting that at least three of the samples were contaminated with these viruses.

Morgan S.M. et al. *Development of a lacticin 3147-enriched whey powder with inhibitory activity against foodborne pathogens.* J Food Prot. 1999; 62(9) : 1011-6.p Abstract: The broad-spectrum bacteriocin lacticin 3147, produced by Lactococcus lactis DPC3147, is inhibitory to a wide range of gram-positive food spoilage and pathogenic organisms. A 10% solution of demineralized whey powder was fermented with DPC3147 at a constant pH of 6.5. The fermentate was spray dried, and the resulting powder exhibited inhibitory activity. The ability of the lacticin 3147-enriched powder to inhibit Listeria monocytogenes Scott A and Staphylococcus aureus 10 was assessed in buffer at both acidic (pH 5) and neutral (pH 7) pH. In addition, the ability of the powder to inhibit L. monocytogenes Scott A in an infant milk formulation was assessed. Resuspension of approximately 10(8) midexponential phase L. monocytogenes Scott A cells in a 10% solution of the lacticin 3147-enriched powder resulted in a 1,000-fold reduction in viable cells at pH 5 and pH 7 after 3 h at 30 degrees C. In the case of S. aureus 10, resuspension of 2.5 x 10(7) midexponential phase cells in a 15% solution of the lacticin 3147-enriched powder at pH 5 resulted in only a 10-fold reduction in viable cell counts, compared with a 1,000-fold reduction at pH 7, following incubation for 3 h at 30 degrees C. The use of the lacticin 3147 powder in an infant milk formulation resulted in greater than a 99% kill of L. monocytogenes within 3 h at 30 degrees C. These results suggest that this bioactive lacticin 3147 food ingredient may find applications in many different foods, including those with pH close to neutrality.

Morgan S.M. et al. *Combination of hydrostatic pressure and lacticin 3147 causes increased killing of Staphylococcus and Listeria.* J Appl Microbiol . 2000; 88(3) : 414-20.p Abstract: The use of hydrostatic pressure and lacticin 3147 treatments were evaluated in milk and whey with a view to combining both treatments for improving the quality of minimally processed dairy foods. The system was evaluated using two foodborne pathogens: Staphylococcus aureus ATCC6538 and Listeria innocua DPC1770. Trials against Staph. aureus ATCC6538 were performed using concentrated lacticin 3147 prepared from culture supernatant. The results demonstrated a more than additive effect when both treatments were used in combination. For example, the combination of 250 MPa (2.2 log reduction) and lacticin 3147 (1 log reduction) resulted in more than 6 logs of kill. Similar results were obtained when a foodgrade powdered form of lacticin 3147 (developed from a spray dried fermentatation of reconstituted demineralized whey powder) was evaluated for the inactivation of L. innocua DPC1770. Furthermore, it was observed that treatment of lacticin 3147 preparations with pressures greater than 400 MPa yielded an increase in bacteriocin activity (equivalent to a doubling of activity). These results indicate that a combination of high pressure and lacticin 3147 may be suitable for improving the quality of minimally processed foods at lower hydrostatic pressure levels.

Morse D.L. et al. *Outbreak and sporadic egg-associated cases of Salmonella enteritidis: New York's experience.* Am J Public Health. 1994; 84(5) : 859-60.p Abstract: Since 1985, egg-associated Salmonella enteritidis has emerged as a major cause of foodborne disease. New York State has been especially affected, with 47 documented egg-associated S enteritidis outbreaks involving 2279 cases and 10 deaths. Individual case reports of salmonella have also increased 56%, and sporadic cases of S enteritidis have been shown to be associated with egg consumption. Further educational and regulatory activities are needed to control this continuing public health problem.

Mosupye F.M. et al. *Microbiological hazard identification and exposure assessment of street food vending in Johannesburg, South Africa.* Int J Food Microbiol. 2000; 61(2-3) : 137-45.p Abstract: One hundred and thirty-two samples of beef, chicken, salad and gravy were collected from two street vendors over eleven replicate surveys to assess microbiological safety and quality. For each food

type samples were collected during preparation and holding. Dish water was also collected and food preparation surfaces swabbed during preparation and display. Standard methods were used to determine aerobic plate counts, Enterobacteriaceae counts, coliform counts and spore counts. Six hundred and seventy-five predominant colonies were isolated from aerobic plate counts of all samples and characterised. The incidence of selected foodborne bacterial pathogens and non-pathogenic E. coli 1 was also determined. In most cases mean bacterial counts of the raw materials were significantly higher ($P < 0.05$) than those of corresponding cooked foods. No significant differences ($P > 0.05$) in all count types were observed between food samples collected during cooking and those collected during holding. In addition, no significant differences ($P > 0.05$) in all count types were observed between prepared salads and their raw materials. Mean bacterial counts of water and swab samples collected from vendor 1 were lower than those of water and swab samples collected from vendor 2.The predominant populations isolated from the aerobic plate counts were Bacillus spp., Staphylococcus spp., Enterobacteriaceae and Alcaligenes spp. Bacillus cereus was detected in 17%, Clostridium perfringens in 1%, Staphylococcus aureus in 3% and Vibrio metchnikovii in 2% of the food samples. Campylobacter jejuni, Listeria monocytogenes, and Escherichia coli 0157:H7 were not detected. Non-pathogenic E. coli 1 was detected in 13% of food samples, in 86 and 36% of dish water samples collected from vendors 1 and 2, respectively, and in 36% of surface swab samples from vendor 2.

Mosupye F.M. et al. *Microbiological quality and safety of ready-to-eat street-vended foods in Johannesburg, South Africa.* J Food Prot. 1999; 62(11) : 1278-84.p Abstract: Fifty-one ready-to-eat street foods, 18 dishwater, and 18 surface swab samples were collected from six vendors in Johannesburg, South Africa. Food temperatures were recorded at the time of sampling. Standard methods were used to determine aerobic plate counts (APCs), spore counts (SCs), and Enterobacteriaceae counts (ECs) for food samples as well as coliform counts (CCs) for water and swab samples. In addition, Petrifilm Escherichia coli count (PC) plates were used for the enumeration of coliforms in food, water, and swab samples. The presence of selected foodborne pathogens in the food samples as well as the presence of nonpathogenic E. coli 1 (in food and water samples) was also tested for. Predominant colonies isolated from APC plates were characterized to the genus level. Holding temperatures for cooked meats and gravies ranged from 42.0 to 94.0 degrees C, and those for uncooked salads ranged from 29.0 to 39.0 degrees C. Mean APC values of 3.4 (+/-0.4) log CFU/g, 4.0 (+/-1.2) log CFU/ml, and 2.1 (+/-0.4) log CFU/25 cm2 were obtained for food, water, and swab samples, respectively. Mean SC values of 1.6 (+/-0.2) log CFU/g and 1.5 (+/-0.3) log CFU/25 cm2 were obtained for food and swab samples, respectively. A mean EC value of 2.0 (+/-0.4) log CFU/g for food samples and mean CC values of 2.5 (+/-0.3) log CFU/ml and 1.3 (+/-0.3) log CFU/25 cm2 for water and swab samples, respectively, were determined. Mean PC values of 1.6 (+/-0.1) log CFU/g, 1.9 (+/-0.6) log CFU/ml, and 1.4 (+/-0.4) log CFU/25 cm2 were determined for food, water, and swab samples, respectively. Bacillus cereus was detected in 22%, Clostridium perfringens in 16%, Salmonella spp. in 2%, and E. coli (non-0157:H+) in 2% of the 51 food samples. E. coli was found in 14 water samples (78%) and in 3 food samples (6%). Campylobacter spp., Listeria monocytogenes, Staphylococcus aureus, Vibrio cholerae, and Yersinia enterocolitica were also tested for in the food samples, but they were not detected. The 340 isolates obtained from APC plates for food, water, and swab samples were predominantly Bacillus spp., Micrococcus spp., and Staphylococcus spp. for all three sample types. It was concluded that the foods analyzed in this study were of acceptable quality and safety.

Motarjemi Y. et al. *Global estimation of foodborne diseases.* World Health Stat Q. 1997; 50(1-2) : 5-11.p Abstract: Foodborne diseases are one of the most widespread health problems, but because of weaknesses in foodborne disease surveillance and variation in reporting systems between countries, it is difficult to make an estimation of their true incidence. This paper describes the constraints in the collection of information on the incidence and/or prevalence of foodborne diseases, including investigation and reporting at national and international levels. It also makes an attempt to semiquantify the occurrence of foodborne diseases of microbial and parasitical origin in different regions of the world.

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Nakama A. et al. *A comparison of Listeria monocytogenes serovar 4b isolates of clinical and food origin in Japan by pulsed-field gel electrophoresis.* Int J Food Microbiol. 1998; 42(3) : 201-6.p Abstract: Pulsed-field gel electrophoresis (PFGE) patterns of 102 L. monocytogenes serovar 4b isolates from patients and foods examined in Japan were compared with 16 isolates from foodborne listeriosis episodes which occurred in North America or Europe. Using a combination of PFGE patterns with the restriction enzymes SmaI, ApaI, AscI and Sse8387I, 82 clinical isolates from Japan were categorized into 45 PFGE types: the largest group of 17 isolates (20.7%) were of the same PFGE type as cultures from the large foodborne outbreaks which occurred in California (1985) and Switzerland (1983-1987). Twenty cultures from foods on retail sale in Japan were classified into 12 PFGE types: four isolates were of three PFGE types also recognized among isolates of clinical origin from Japan, including the predominant clinical type.

Nastasi A. et al. *Epidemiological analysis of strains of Salmonella enterica serotype Enteritidis from foodborne outbreaks occurring in Italy, 1980-1994.* J Med Microbiol. 1997; 46(5) : 377-82.p Abstract: Polymerase chain reaction (PCR-) ribotyping was performed on 243 strains of Salmonella enterica serotype Enteritidis isolated during the

years 1980-1994 from 58 foodborne outbreaks occurring in different regions of Italy. The majority (37) of the outbreaks were attributed to phage type (PT) 4, followed by PT1 (seven outbreaks); the latter was identified in 1993 in Italy in epidemic strains of Enteritidis. In eight cases more than one phage type was recognised from a single event. Nine PCR-ribotypes (PCR-RTs) were detected, with a strong prevalence of PCR-RTs f7 and e5 (23 and 21 outbreaks, respectively). In two instances two distinct PCR-RTs were identified within strains from a single outbreak. All but one of the PT1 outbreaks were caused by PCR-RT f7, whereas PT4 outbreaks could be subdivided into six subsets. Clustering of isolates was consistent with data obtained from epidemiological investigations. PCR-ribotyping proved to be an effective and reliable tool for subtyping isolates of Enteritidis belonging to the most frequent phage types. Nevertheless, in terms of laboratory expertise and lack of inter-laboratory standardisation, this typing technique is best suited for reference laboratories.

Nastasi A. et al. *A foodborne outbreak of Salmonella enteritidis vehicled by duck and hen eggs in southern Italy.* New Microbiol. 1998; 21(1) : 93-6.p Abstract: A foodborne outbreak of Salmonella enteritidis PT4 is described. This microrganism was detected in a home-made dessert, in the duck and hen eggs used for its preparation and in faecal samples of six persons involved in the outbreak. PCR ribotyping revealed that all the strains shared a profile of S. enteritidis never previously identified in southern Italy and quite different from that of the strains simultaneously isolated in the same geographic area. The possible identification of a clonal variant of S. enteritidis PT4 host-adapted to duck is hypothesized.

Nauschuetz W. *Emerging foodborne pathogens: enterohemorrhagic Escherichia coli.* Clin Lab Sci. 1998; 11(5) : 298-304.p Abstract: In 1982, a new pathogen caused an outbreak of hemorrhagic colitis in this country. This new pathogen, Escherichia coli O157:H7, was not a known enteropathogen prior to this time. Since 1982, this organism has become the most commonly isolated pathogen from patients with bloody stools. Health officials estimate that E. coli O157:H7 causes 20,000 cases of hemorrhagic colitis annually in the U.S. Approximately 5% of all hemorrhagic colitis patients experience serious sequelae involving hemolytic anemia, thrombocytopenia, and kidney failure, and about 250 patients die each year with E. coli O157:H7 hemorrhagic colitis and sequelae. Even as many clinical laboratories become more efficient at detecting E. coli O157:H7 using simple media, other strains of enterohemorrhagic E. coli are appearing as causes of hemorrhagic colitis and hemolytic uremic syndrome. These non-O157:H7 are more difficult to detect and identify, and present a challenge to clinical microbiologists.

Nazarowec-White M. et al. *Enterobacter sakazakii: a review.* Int J Food Microbiol. 1997; 34(2) : 103-13.p Abstract: Enterobacter sakazakii, previously referred to as a yellow-pigmented Enterobacter cloacae was designated as a unique species in 1980. This reclassification was based on differences from E. cloacae in DNA relatedness, pigment production and biochemical reactions. E. sakazakii has been implicated in a severe form of neonatal meningitis. Although studies have failed to identify an environmental source for the organism, dried-infant formula has been implicated in both outbreaks and sporadic cases of E. sakazakii meningitis. The high mortality rate (40-80%), the severity of the infection in infants, plus the scarcity of information on the ecology and pathogenicity of this organism warranted a review of the clinical and microbiological features of this putative foodborne pathogen.

Neimann B.J. et al. *[An outbreak of Salmonella enteritidis at the New Year celebration of the Copenhagen Medical Association].* Ugeskr Laeger. 1999; 161(19) : 2803-6.p Abstract: In order to determine the extent and infectious vehicle of an outbreak of Salmonella enteritidis phage type 6 at the New Year celebration of the Copenhagen Medical Association on 15 January 1999, a cohort study including 77 guests (90% of the participants) and 11 staff was carried out. There was little variation in the degree of exposure among the guests, meaning that identification of the probable infectious vehicle was not possible here. However, among the staff, intake of minced raw salmon was associated with increased risk of disease. Uncooked eggs were used in the preparation of this dish and since S. enteritidis phage type 6 is in Denmark almost exclusively found among egg-laying hens, these findings led to the conclusion that the outbreak was most likely caused by the use of raw eggs. The importance of notification of suspected foodborne disease and microbiological examination of people thereby exposed is stressed.

Nguyen-the C. et al. *The microbiology of minimally processed fresh fruits and vegetables.* Crit Rev Food Sci Nutr. 1994; 34(4) : 371-401.p Abstract: Minimally processed fresh (MPF) fruits and vegetables are good media for growth of microorganisms. They have been involved in outbreaks because of the consumption of products contaminated by pathogens. They are also sensitive to various spoilage microorganisms such as pectinolytic bacteria, saprophytic Gram-negative bacteria, lactic acid bacteria, and yeasts. Contamination of MPF fruits and vegetables occurs at every stage of the food chain, from cultivation to processing. Polluted environments during cultivation or poor hygienic conditions in processing increase the risk of contamination with foodborne pathogens. Although MPF fruits and vegetables may harbor psychrotrophic microorganisms such as fluorescent pseudomonads or Listeria monocytogenes, good control of refrigeration temperature limits growth of spoilage and pathogenic microorganisms. Modified atmospheres are often efficient to maintain or improve visual organoleptic quality of MPF fruits and vegetables, but their effects on microorganisms are inconsistent. Chemical disinfection can partially reduce the initial bacterial contamination; irradiation seems to be more efficient. The applications of legislations and quality assurance systems to control contamination, survival, and

growth of foodborne pathogens in MPF fruits and vegetables are discussed.

Nocera D. et al. *Characterization of Listeria strains from a foodborne listeriosis outbreak by rDNA gene restriction patterns compared to four other typing methods.* Eur J Clin Microbiol Infect Dis. 1993; 12(3) : 162-9.p Abstract: The rDNA gene restriction patterns of 134 isolates of Listeria species were determined with pKK3535--a pBR322 derived plasmid containing an Escherichia coli rRNA operon--used as a probe following digestion of chromosomal DNA by EcoRI endonuclease. Nineteen reference and type strains representing all species and serotypes of Listeria showed 17 distinct ribotypes. One hundred and fifteen wild strains of Listeria monocytogenes were ribotyped and the results were compared to those of serotyping, phage typing, multilocus enzyme electrophoresis (MEE) and restriction endonuclease analysis (REA). Ninety-six Listeria monocytogenes serotype 4b wild strains displayed six distinct ribotypes (I-VI), 72% (69/96) of them clustering in two very close rDNA patterns (I and II) of eight and nine bands, respectively. The same 96 strains displayed six REA patterns and eight MEE electrotypes. Among the 96 Listeria monocytogenes 4b isolates, the 34 epidemic strains defined by phage typing and by epidemiological data all belonged to one ribotype (ribotype I) representing 56% of the strains belonging to this ribotype. These same 34 epidemic strains were also grouped by REA and MEE typing in a unique profile (REA-A) and MEE electrotype (ET 1). Twenty-two Listeria monocytogenes strains of serogroup 1/2 analyzed by rDNA typing showed nine distinct ribotypes. For the 96 Listeria monocytogenes 4b strains studied, the discriminatory index was highest for phage typing and for any combination including phage typing. Ribotyping appears to be a well reproducible molecular typing method and could be a useful complement to other typing methods for the epidemiological study of listeriosis.

Notermans S. et al. *Existing and emerging foodborne diseases.* Int J Food Microbiol. 1992; 15(3-4) : 197-205.p Abstract: Foodborne diseases, i.e. illnesses due to contaminated food, are one of the most widespread problems of the contemporary world. They are toxic or infectious by nature and are caused by agents which enter the body through the ingestion of contaminated food or water. These agents can be chemical like pesticide residues and toxic metals or biological like pathogenic microorganisms. Foods contaminated by biological agents are, however, the major cause of foodborne disease. Data recorded in different countries show that the incidence of some of these diseases has increased dramatically over the past few years, but because of under-reporting the data are of limited value and cannot be compared between countries. In most countries, individual cases of illness are usually not reported. A sentinel surveillance system, started as a pilot study in the Netherlands, was shown to be feasible for the registration of some foodborne infections. Based on this study, it can be estimated that each year Salmonella and Campylobacter cause respectively about 12,000 and 25,000 cases of acute enteritis per million. Case-control studies clearly implicate poultry products as an important source of acute enteritis. New developments in food production and changing trends in food consumption lead to the emergence of new hazards. Additionally, because the population is aging and there has been an increase in the number of individuals with underlying diseases, the state of public health is deteriorating. Campylobacter, Salmonella enteritidis and enterohemorrhagic Escherichia coli are examples of microorganisms that have the opportunity to increase as a consequence of intensive husbandry. Listeria monocytogenes is an example of an organism that causes disease in immunosuppressed individuals.

Notermans S. et al. *Incorporation of elements of quantitative risk analysis in the HACCP system.* Int J Food Microbiol. 1996; 30(1-2) : 157-73.p Abstract: Foodborne bacterial diseases cause considerable morbidity and mortality throughout the world. Preventive measures such as good manufacturing practices (GMP), supplemented by the hazard analysis critical control point (HACCP) system, have been introduced as a means of ensuring the production of safe food. However, their use does not necessarily provide quantitative information on the risks associated with the consumption of a particular food product. To obtain such information, elements of quantitative risk analysis (QRA) need to be used. QRA is defined as a stepwise analysis of the health risks associated with a specific type of food product, resulting in an estimation of the probability of occurrence of adverse effects on health following consumption of the food in question. It also includes an analysis of the nature of the risks. Taking this definition, five successive steps can be recognized: hazard identification, exposure assessment, dose response assessment, risk characterization and risk management. Food production is a dynamic activity, involving changes in, e.g. the composition and microbial quality of raw materials due to seasonal variation. Also, there may be continuing changes in processing conditions and in product composition due to consumer demands. Therefore, it will be desirable to incorporate QRA in existing safety assurance systems, such as HACCP, when sufficient information is available to permit this approach.

Notermans S. et al. *Evaluation and interpretation of data obtained with immunoassays and DNA-DNA hybridization techniques.* Int J Food Microbiol. 1990; 11(1) : 35-49.p Abstract: During the last decade several new analytical techniques have been developed for testing food products and clinical samples. One technique uses sensitive immunoassays such as enzyme-linked immunosorbent assay (ELISA) and latex agglutination. The most important step in developing sensitive immunoassays is the evaluation of the assay for specificity, cross-reactivity and sensitivity. False-negative results can easily be detected by adding known quantities of antigen to the sample. The most appropriate way to detect false-positive results is the specific inhibition of the immunological reaction by

addition to the test-sample of either synthetic epitopes or anti-idiotype antibodies. The progress in recombinant DNA techniques now offers opportunities for application as analytical tools in food and clinical microbiology. Methods are being developed to detect microorganisms by their nucleic acid sequence using the so-called hybridization procedure. With this technique, labelled DNA fragments (probes) are hybridized with a complementary base sequence present in the microorganism. Foodborne pathogens can be detected by using a probe with a complementary base sequence which codes for toxin production. DNA-DNA hybridization techniques may replace the traditional cultural techniques for assaying pathogenic micro-organisms. However, more experience with these techniques is needed before further evaluation can be given.

Notermans S. et al. *Immunological methods for detection of foodborne pathogens and their toxins.* Int J Food Microbiol. 1991; 12(1) : 91-102.p Abstract: Improved methods to detect microorganisms and their toxins introduced during the last decade involve among others recombinant DNA techniques and various immuno-assays such as the enzyme-linked immunosorbent assay and the latex agglutination. Immuno-assays are based on a quantitative reaction of an antigen (bacterial metabolite, e.g., toxin) with its antibody. Therefore, they are suited for detection of microorganisms based on their production of specific antigens and for quantitative detection of bacterial toxins. Sensitivity and specificity of immuno-assays are mainly determined by the antiserum used. In this respect the use of well selected monoclonal antibodies can be of advantage. With the enzyme-linked immunosorbent assay and latex agglutination test quantities of 0.1-1 ng of antigen/ml can be detected. Of both techniques the latex agglutination method has several advantages; the method is simple, inexpensive and rapid. Since each immuno-assay is sensitive to non-specific reactions, recognition of false positive results is necessary. The most appropriate method for this is to add an inhibitor to the test sample which blocks specifically the paratope of the immunoglobulin. Another general disadvantage of immuno-assays is that only the antigenicity is determined and this may differ from the actual toxicity. Therefore, antibodies should be used that react with the toxic centre(s) of the molecule, which can be accomplished by using well selected monoclonal antibodies.

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O'Mahony M. et al. *An outbreak of foodborne botulism associated with contaminated hazelnut yoghurt.* Epidemiol Infect. 1990; 104(3) : 389-95.p Abstract: The largest recorded outbreak of foodborne botulism in the United Kingdom occurred in June 1989. A total of 27 patients was affected; one patient died. Twenty-five of the patients had eaten one brand of hazelnut yoghurt in the week before the onset of symptoms. This yoghurt contained hazelnut conserve sweetened with aspartame rather than sugar. Clostridium botulinum type B toxin was detected in a blown can of hazelnut conserve, opened and unopened cartons of hazelnut yoghurt, and one faecal specimen. Cl. botulinum type B was subsequently cultured from both opened and unopened cartons of the hazelnut yoghurt and from one faecal specimen. Investigations indicated that the processing of the conserve was inadequate to destroy Cl. botulinum spores. Control measures included the cessation of all yoghurt production by the implicated producer, the withdrawal of the firm's yoghurts from sale, the recall of cans of the hazelnut conserve, and advice to the general public to avoid the consumption of all hazelnut yoghurts.

Offermann U. et al. *[The prevalence of salmonella, yersinia and mycobacteria in slaughtered pigs in Switzerland].* Schweiz Arch Tierheilkd. 1999; 141(11) : 509-15.p Abstract: Clinically healthy food animals can be reservoirs for various foodborne pathogens. In general, such animals do not have lesions that are visible during meat inspection. Pigs are considered to be carriers of salmonella, yersinia and mycobacteria, but the risk of transmission to humans is difficult to assess. The aim of this study was to estimate the actual prevalence of the three above mentioned pathogens in the Swiss pig population and to comment on their significance. A total of 570 samples each of tonsils and mesenteric lymphnodes, were collected at two slaughterhouses from carcasses of apparently healthy pigs and analyzed for the presence of salmonella, yersinia and mycobacteria. The prevalence of salmonella (0.9%) was found to be lower than--while that of yersinia (8.1%) and mycobacteria (12.8%) about equal to--results reported from other European countries. Yersinia typing showed that serotype O:9 of Yersinia enterocolitica (2.5%) was 6 to 7 times more frequent than serotype O:3 (0.4%)--formerly the most frequent serotype. Mycobacterium avium was the most frequent isolate (90.7%) among the mycobacteria isolated. Although all three pathogens are present in the Swiss pig population, we consider the risk of transmission to humans via consumption of pork as low. Appropriate preventive measures and quality management should contribute to keep the risk under control.

Ollinger-Snyder P. et al. *Food safety: review and implications for dietitians and dietetic technicians.* J Am Diet Assoc. 1996; 96(2) : 163-8, 171; quiz 169-70.p Abstract: Section 103 (d) of the Americans with Disabilities Act directs the secretary of health and human services to identify, publish, and annually review a list of pathogens transmitted via food contaminated by infected food handlers. The secretary is also directed to publish means by which diseases on the list are transmitted. The intent of the list is to protect disabled food handlers when they become ill and to provide managers with information for determining when to remove or reassign disabled food handlers who have infectious or communicable diseases to jobs that do not involve handling food. Pathogens often transmitted via food contaminated by infected food handlers are Salmonella typhi, Shigella species, Staphylococcus aureus, Streptococcus pyogenes, hepatitis A virus, and the Norwalk and Norwalk-like viruses. This

article discusses section 103 (d) and for each of the six pathogens describes characteristics and growth requirements, types of foods involved in outbreaks, factors that contribute to foodborne outbreaks, and prevention and control measures. Human beings are the only reservoir of Sal typhi. The source of Shigella species is the intestinal tract of human beings and other primates. Human beings are the common reservoir of Staph aureus and Strep pyogenes. Staph aureus is frequently found in the nose and on the skin of healthy people, whereas Strep pyogenes is carried in the throat of infected or asymptomatic carriers. Foodborne viruses of public health concern originate in the human intestine. Foods that favor the multiplication of Sal typhi are often foods that require no cooking. Many outbreaks of foodborne disease attributed to Shigella species and viruses have been associated with salads. Moist, high-protein, and salty foods that have been cooked are most often involved in outbreaks of staphylococcal foodborne illness. Foods usually implicated in Strep pyogenes outbreaks are predominately composed of milk, eggs, or meat. Dietitians and dietetic technicians can use three approaches to reduce the incidence of foodborne disease attributed to food handlers: conducting training and education programs, implementing a Hazard Analysis and Critical Control Points system, and supporting certification of foodservice managers.

Olsen A.R. *Regulatory action criteria for filth and other extraneous materials. III. Review of flies and foodborne enteric disease.* Regul Toxicol Pharmacol. 1998; 28(3) : 199-211.p Abstract: Forty-seven species of flies have been reliably associated with filthy conditions that might allow the spread of foodborne pathogens. These are categorized as "filth flies." Of that 47, only 21 species represent a potential threat to human health as scientifically proven causative agents of foodborne myiasis or as carriers of enteropathogenic Escherichia coli, Salmonella, Shigella, and other foodborne pathogens. These 21 species are categorized as "disease-causing flies" based on strict scientific criteria. The criteria are association with E. coli, Salmonella, AND Shigella; synanthropy; endophily; communicative behavior; attraction to both excrement and food products; and recognition by authorities as a potential health hazard. Within Hazard Analysis and Critical Control Point and other U.S. Food and Drug Administration regulatory frameworks, disease-causing flies are contributing factors to the spread of foodborne disease that require preventive and corrective actions as appropriate under Sanitation Standard Operating Procedures, Good Manufacturing Practices, or pest control programs.

Olsen A.R. et al. *Isolation of Salmonella spp. from the housefly, Musca domestica L., and the dump fly, Hydrotaea aenescens (Wiedemann) (Diptera: Muscidae), at caged-layer houses.* J Food Prot. 2000; 63(7) : 958-60.p Abstract: Flies, especially houseflies, are widely recognized as potential reservoirs and vectors of foodborne Salmonella pathogens. In this study, flies were collected at caged-layer facilities that had produced eggs that were implicated as the food vehicle in two recent outbreaks of Salmonella Enteritidis infections. The flies were separated by species into pools for microbiological testing. A total of 15 species pools of houseflies, Musca domestica L., and 7 species pools of bronze dump flies, Hydrotaea aenescens (Wiedemann) (Diptera: Muscidae), were analyzed. Salmonella Enteritidis was isolated from 2 of the 15 pools of houseflies. Other species of Salmonella were isolated from three pools of flies, including Salmonella Infantis from houseflies and from dump flies and Salmonella Heidelberg from houseflies. Salmonella Mbandaka was isolated from a lesser mealworm, Alphitobius diaperinus (Panzer) (Coleoptera: Tenebrionidae).

Olsen S.J. et al. *Surveillance for foodborne-disease outbreaks--United States, 1993-1997.* Mor Mortal Wkly Rep CDC Surveill Summ. 2000; 49(1) : 1-62.p Abstract: PROBLEM/CONDITION: Since 1973, CDC has maintained a collaborative surveillance program for collection and periodic reporting of data on the occurrence and causes of foodborne-disease outbreaks (FBDOs) in the United States. REPORTING PERIOD COVERED: This summary reviews data from January 1993 through December 1997. DESCRIPTION OF SYSTEM: The Foodborne-Disease Outbreak Surveillance System reviews data concerning FBDOs, defined as the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food. State and local public health departments have primary responsibility for identifying and investigating FBDOs. State, local, and territorial health departments use a standard form to report these outbreaks to CDC. RESULTS: During 1993-1997, a total of 2,751 outbreaks of foodborne disease were reported (489 in 1993, 653 in 1994, 628 in 1995, 477 in 1996, and 504 in 1997). These outbreaks caused a reported 86,058 persons to become ill. Among outbreaks for which the etiology was determined, bacterial pathogens caused the largest percentage of outbreaks (75%) and the largest percentage of cases (86%). Salmonella serotype Enteritidis accounted for the largest number of outbreaks, cases, and deaths; most of these outbreaks were attributed to eating eggs. Chemical agents caused 17% of outbreaks and 1% of cases; viruses, 6% of outbreaks and 8% of cases; and parasites, 2% of outbreaks and 5% of cases. INTERPRETATION: The annual number of FBDOs reported to CDC did not change substantially during this period or from previous years. During this reporting period, S. Enteritidis continued to be a major cause of illness and death. In addition, multistate outbreaks caused by contaminated produce and outbreaks caused by Escherichia coli O157:H7 remained prominent. ACTIONS TAKEN: Current methods to detect FBDOs are improving, and several changes to improve the ease and timeliness of reporting FBDO data are occurring (e.g., a revised form to simplify FBDO reporting by state health departments and electronic reporting methods). State and local health departments continue to investigate and report FBDOs as part of efforts to better understand and define the epidemiology of foodborne disease in the United States. At the regional and national levels, surveillance data provide an indication of the etiologic agents, vehicles of transmission, and contributing factors associated with

FBDOs and help direct public health actions to reduce illness and death caused by FBDOs.

Olsvik O. et al. *Magnetic separation techniques in diagnostic microbiology.* Clin Microbiol Rev. 1994; 7(1) : 43-54.p Abstract: The principles of magnetic separation aided by antibodies or other specific binding molecules have been used for isolation of specific viable whole organisms, antigens, or nucleic acids. Whereas growth on selective media may be helpful in isolation of a certain bacterial species, immunomagnetic separation (IMS) technology can isolate strains possessing specific and characteristic surface antigens. Further separation, cultivation, and identification of the isolate can be performed by traditional biochemical, immunologic, or molecular methods. PCR can be used for amplification and identification of genes of diagnostic importance for a target organism. The combination of IMS and PCR reduces the assay time to several hours while increasing both specificity and sensitivity. Use of streptavidin-coated magnetic beads for separation of amplified DNA fragments, containing both biotin and a signal molecule, has allowed for the conversion of the traditional PCR into an easy-to-read microtiter plate format. The bead-bound PCR amplicons can also easily be sequenced in an automated DNA sequencer. The latter technique makes it possible to obtain sequence data of 300 to 600 bases from 20 to 30 strains, starting with clinical samples, within 12 to 24 h. Sequence data can be used for both diagnostic and epidemiologic purposes. IMS has been demonstrated to be a useful method in diagnostic microbiology. Most recent publications describe IMS as a method for enhancing the specificity and sensitivity of other detection systems, such as PCR, and providing considerable savings in time compared with traditional diagnostic systems. The relevance to clinical diagnosis has, however, not yet been fully established for all of these new test principles. In the case of PCR, for example, the presence of specific DNA in a food sample does not demonstrate the presence of a live organism capable of inducing a disease. However, all tests offering increased sensitivity and specificity of detection, combined with reduced time of analysis, have to be seriously evaluated.

Orriss G.D. *Animal diseases of public health importance.* Emerg Infect Dis. 1997; 3(4) : 497-502.p Abstract: The Food and Agriculture Organization's (FAO) interest in emerging diseases caused by foodborne pathogens derives from its role as the leading United Nations agency with a mandate for food quality and safety matters. The Food Quality and Standards Service of FAO's Food and Nutrition Division is active in all areas related to food safety and implements the FAO/World Health Organization Food Standards Program. Its activities include providing assistance to FAO's member nations in addressing problems, strengthening infrastructure, promoting standardization as a means of facilitating trade, and safeguarding the interests of consumers. This paper considers the importance of emerging foodborne diseases from the perspectives of the consumer, international trade in food, producers and processors, and developing countries and addresses prevention and control measures.

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Palmer S. et al. *Problems in the diagnosis of foodborne infection in general practice.* Epidemiol Infect. 1996; 117(3) : 479-84.p Abstract: The incidence of acute gastroenteritis and self suspected food poisoning in general practice populations was compared with consultation rates in four group practices during a 3-month winter period and a 2-month autumn period. The average monthly consultation rate for acute gastroenteritis and self suspected food poisoning was 0.3% and 0.06% respectively. However, over the same period, on average, an estimated 7% of the practice population per month reported an acute gastroenteritis illness, and 0.7% suspected a food poisoning illness. Only about one in 26 people who suffer an acute episode of gastroenteritis consult their general practitioner (GP). In two practices, faecal samples were sought from all patient cases; the isolation rate for salmonellas was 2% (3/191) and for campylobacters it was 12% (23/191). In the other two practices following routine management, the isolation rate for salmonellas was 9% (6/64) and for campylobacters it was 2% (1/64). Isolation of faecal pathogens was not associated with patients' suspicion of food poisoning. A history of eating out in the week before onset was associated with a significantly increased yield of salmonellas and campylobacters.

Panella H. et al. *[An evaluation of the epidemiological surveillance system for infectious diseases in the Barcelona Olympic Games of 1992].* Gac Sanit. 1995; 9(47) : 84-90.p Abstract: Due to the 1992 Barcelona Olympic Games some modifications were introduced in the epidemiologic surveillance system for infectious diseases in place in the city, in order to expand its coverage and shorten its timeliness in detecting outbreaks and investigating cases. These modifications were introduced for a group conditions (hepatitis, meningococcal disease, legionnaire's disease and food outbreaks), selected on the basis of incidence, time of the year, previous experience in other settings, and likelihood of outbreak occurrence. In the June-August 1992 period (Olympic period), no increases in the incidence of selected conditions were observed when compared to the same period in 1986 to 1991. Major changes were observed in the source of food outbreak reporting, with a large increase in outbreaks reported by emergency room departments. There was an increase in the number of domestic foodborne outbreaks and a reduction in those related with restaurants. Timeliness in the detection of cases was shortened. The use of similar modifications can be useful for epidemiologic surveillance systems in other comparable settings or occasions.

Panisello P.J. et al. *Application of foodborne disease outbreak data in the development and maintenance of HACCP systems.* Int J Food Microbiol. 2000; 59(3) : 221-34.p

Abstract: Five-hundred and thirty general foodborne outbreaks of food poisoning reported in England and Wales between 1992 and 1996 were reviewed to study their application to the development and maintenance of HACCP systems. Retrospective investigations of foodborne disease outbreaks provided information on aetiological agents, food vehicles and factors that contributed to the outbreaks. Salmonella spp. and foods of animal origin (red meat, poultry and seafood) were most frequently associated with outbreaks during this period. Improper cooking, inadequate storage, cross-contamination and use of raw ingredients in the preparation of food were the most common factors contributing to outbreaks. Classification and cross tabulation of surveillance information relating to aetiological agents, food vehicles and contributory factors facilitates hazard analysis. In forming control measures and their corresponding critical limits, this approach focuses monitoring on those aspects that are critical to the safety of the product. Incorporation of epidemiological data in the documentation of HACCP systems provides assurance that the system is based on the best scientific information available.

Papathanasopoulos M.A. et al. *Antibacterial activity of three Leuconostoc strains isolated from vacuum-packaged processed meats.* J Basic Microbiol. 1994; 34(3) : 173-82.p Abstract: One hundred and fifty lactic acid bacteria (LAB) isolated from vacuum-packaged processed meats were screened for antagonistic activity against various food spoilage microorganisms and foodborne pathogens. Nineteen strains produced bacteriocins active against closely related LAB and Listeria strains. Leuconostoc carnosum (LA54a and TA26b) and Leuconostoc mesenteroides subspecies dextranicum (TA33a) produced bacteriocins that were susceptible to proteolytic enzymes, but not to catalase, lysozyme or chloroform. They were heat stable up to 100 degrees C for thirty minutes at pH 2 to 7, and exerted a bacteriolytic effect. Bacteriocin production by all Leuconostoc strains was growth associated, occurring at incubation temperatures of 0 degrees C to 30 degrees C and initial medium pH 4.5 to 7.5. Probing of plasmid DNA from the three Leuconostoc strains with an oligonucleotide probe homologous to the nucleotide sequence of leucocin A-UAL 187 indicated plasmid-mediated bacteriocin production. Homology of the three Leuconostoc bacteriocin-coding genes to the amino-terminal end of the leucocin A-UAL 187 gene from Leuconostoc gelidum UAL 187 is therefore suggested. This evidence implies that all three Leuconostoc strains produce type 2, Listeria active bacteriocins.

Paredes P. et al. *Etiology of travelers' diarrhea on a Caribbean island.* J Travel Med. 2000; 7(1) : 15-8.p Abstract: BACKGROUND: Between December 6, 1994 and March 10, 1996, a study of the etiology of diarrhea was carried out among 332 travelers to five all-inclusive hotels in Negril, Jamaica. METHODS: Stool specimens were collected and sent to Montego Bay for laboratory analysis. Escherichia coli strains isolated at the Jamaican laboratory were sent to Houston for toxin testing. RESULTS: A recognized enteropathogen was found in 118 of the 332 (35.5%) cases. Enterotoxigenic E. coli (ETEC) were the most commonly identified pathogen (87/332; 26.2%) followed by Salmonella (4.2%) and Shigella (4.2%). Clustering of etiologically defined cases was studied at each hotel. A cluster was defined as 2 or more cases with the same pathogen identified in the same hotel within 7 days. In the 3 hotels with the highest number of cases of diarrhea, enteropathogens were part of a cluster in 65 of 99 cases (65.7%) of diarrhea of which an etiologic agent was identified. In the other 2 hotels, only 4 of 20 cases (20%) occurred in clusters. CONCLUSIONS: A total of 25 clusters of travelers' diarrhea cases was detected at the five hotels during the study period. Seventeen of 25 (68%) ETEC isolations occurred as part of a clustering of diarrhea cases. The largest outbreak of pathogen-identified diarrhea consisted of 7 cases of ETEC producing both heat-stable and heat-labile enterotoxins. In the Jamaican hotels with all inclusive meal packages most diarrhea cases occurred as small clusters, presumably as the result of foodborne outbreaks.

Parish M.E. *Public health and nonpasteurized fruit juices.* Crit Rev Microbiol. 1997; 23(2) : 109-19.p Abstract: Well publicized outbreaks of foodborne illness have occurred in recent years due to consumption of commercial, nonpasteurized ("fresh" or "unpasteurized") fruit juices. Nonpasteurized and heat treated juices have been associated with at least 15 foodborne illness outbreaks since the early 1900s. Disease syndromes have included salmonellosis, typhoid fever, cyrptosporidiosis, Escherichia coli-related diarrhea, and hemolytic uremia. Mortality has occasionally occurred during these outbreaks. An increase in the number of reported outbreaks in recent years possibly reflects greater consumption of fresh juices and closer scrutiny of these products by medical and public health authorities. This article reviews the fruit juice borne outbreaks in the 1900s, methods to control pathogens, and regulatory issues related to production of nonpasteurized fruit juices in the U.S.

Pawelzik M. *Pathogenic Escherichia coli O157:H7 and their detection.* Acta Microbiol Hung. 1991; 38(3-4) : 315-20.p Abstract: Enterohaemorrhagic Escherichia coli O157:H7 is of major concern to the food industry due to high pathogenicity of this foodborne organism. For the detection of these bacteria a special agar medium with a fluorogenic substrate has been developed. The medium uses the characteristics of this E. coli serotype not to ferment sorbitol and not to produce beta-glucuronidase. In contrast, approximately 96% of all other strains of E. coli are sorbitol-positive and nearly all of them are beta-glucuronidase-positive. For discrimination between Proteus and E. coli O157:H7 which are both sorbitol- and beta-glucuronidase-negative, sodium thiosulphate and ferrio ammonium citrate were added. This leads to a brownish colour of the Proteus colonies due to their production of hydrogen sulphide. Growth of the gram-positive flora was inhibited by the addition of sodium deoxycholate.

Pebody R.G. et al. *Foodborne outbreaks of hepatitis A in a low endemic country: an emerging problem?* Epidemiol Infect. 1998; 120(1) : 55-9.p Abstract: This paper describes 2 outbreaks of hepatitis A infection in Finland, a very low endemic area of hepatitis A infection, where a large proportion of the population is now susceptible to infection by hepatitis A virus (HAV). The first outbreak involved people attending several schools and day-care centres; the second employees of several bank branches in a different city. The initial investigation revealed that both were related to food distributed widely from separate central kitchens. Two separate case-control studies implicated imported salad food items as the most likely vehicle of infection. HAV was detected in the stool of cases from both outbreaks using reverse-transcriptase polymerase chain reaction; however, comparison of viral genome sequences proved that the viruses were of different origin and hence the outbreaks, although occurring simultaneously, were not linked. Foodborne outbreaks of HAV may represent an increasing problem in populations not immune to HAV.

Peng H. et al. *Rapid detection of low levels of Listeria in foods and next-day confirmation of L. monocytogenes.* J Microbiol Methods. 2000; 41(2) : 113-20.p Abstract: Outbreaks of foodborne listeriosis caused by Listeria monocytogenes in recent years, and the high mortality rate associated with listeriosis, have raised the need for reliable and rapid detection of the pathogen. A simple, automated method was developed for the detection of Listeria organisms in foods. It consists of a 6-h pre-enrichment step followed by overnight incubation in selective broth at 35 degrees C. Changes in light transmittance in the selective broth are registered continuously by an optical sensor of the BioSys instrument (MicroSys, Ann Arbor, MI), and recorded in the computer. Esculin hydrolysis by listeriae results in black coloration of the media that causes a sharp drop in light transmittance, whereas negative samples remain colorless. Confirmation of L. monocytogenes is carried out only on esculin-positive samples and is completed within 6 h. Detection of 10-50 cells of Listeria inoculated into 25 g of food was confirmed in shell eggs, milk and ground beef. Naturally contaminated raw and ready-to-eat foods were further screened to validate the procedure.

Pepin M. et al. *Public health hazards from small ruminant meat products in Europe.* Rev Sci Tech. 1997; 16(2) : 415-25.p Abstract: Foodborne diseases, in particular those related to meat and meat products, have recently become a matter of great public concern. Sheep and goat meat can transmit infections and diseases either through handling during preparation procedures or as a result of ingestion by the consumer. The authors highlight the second route of contamination in relation to meat and meat products from small ruminants in European countries. Among the most important diseases transmitted by mutton and goat meat, toxoplasmosis remains the greatest threat, particularly in immuno-compromised people and in pregnant women. Other pathogens which may be associated with the consumption of meat from small ruminants include: Clostridium perfringens, Cryptosporidium parvum and Campylobacter jejuni. As with other ruminant species, Escherichia coli O157:H7 can be considered as an emerging pathogen, for which control efforts must be made. The classical zoonoses (brucellosis, Q fever, hydatidosis) are also presented here, although the major source of contamination for these diseases remains contact with infected animals or the handling of carcasses. The fact that the association of foodborne diseases with mutton and goat meat is less frequent than with the meat of other animal species should be noted, for the following reasons: a) lower levels of production; b) less intensive production, leading to a weaker microbial contamination; c) mutton and goat meat are subjected to processing less often than other meats; d) the usual boiling or cooking processes.

Peresi J.T. et al. *[Food borne disease outbreaks caused by Salmonella enteritidis].* Rev Saude Publica. 1998; 32(5) : 477-83.p Abstract: OBJECTIVE: It is to describe outbreaks of salmonellosis reported from July 1993 through June 1997 in the Northwest region of S. Paulo State, Brazil, one of the areas where several foodborne outbreaks of salmonellosis have been recently detected. METHOD: Data of 19 epidemiological investigations were analysed; 87 stool specimens and 38 food samples (including 12 of shell eggs) were processed for microbiological analysis. Salmonella strains were identified by serotyping, phagetyping and antimicrobial susceptibility testing. RESULTS: There were 906 ill persons including 295 hospitalized patients. Phage type 4 (PT 4) Salmonella Enteritidis strains were isolated from 80.5% of stool samples, from all food samples and from 41.7% of eggs. Of the outbreaks, 95.7% were associated with the consumption of food containing raw or undercooked eggs. All strains were susceptible to the 13 antimicrobials, except the strains from the nosocomial outbreak. CONCLUSIONS: The results obtained show the need for the implementation of control measures regarding egg and storage, as well as for guidance to the public as to the risks involved in the consumption of inadequately prepared eggs.

Persson U. et al. *The economic impact of poultry-borne salmonellosis: how much should be spent on prophylaxis?* Int J Food Microbiol. 1992; 15(3-4) : 207-13.p Abstract: Foodborne salmonellosis constitutes a major health problem in many countries. Moreover, the costs associated with salmonellosis could be considerable. There are thus strong arguments for preventive efforts. Ambitious, often government-sponsored, programmes aimed at preventing and controlling salmonellosis in for instance, poultry production represent one alternative to lower salmonellosis-related illness and economic costs. On the other hand, such comprehensive programmes are rather resource-demanding. From the economic point of view the key problem is to find the optimal level for prophylactic measures. The purpose of this study is to compare two different approaches to preventing poultry-borne salmonellosis among humans. We identify and compare the economic costs of illness due to poultry-borne salmonellosis and the costs of salmonella control in

England and Wales and Sweden, respectively. An alternative option is then introduced: the concept of competitive exclusion (CE). Our results show that the cost of illness constitutes the major part of the total cost in England and Wales, whereas in Sweden, the control cost amounts to 95% of the total cost. By using the CE concept, the cost of illness due to poultry-borne salmonellosis in England and Wales could be reduced by at least GB pound 12.6 million. These advantages apply to individuals, producers, and to society, and we thus conclude that the CE concept is a very cost-effective way of using scarce resources.

Petersen K.E. et al. *Agents, vehicles, and causal inference in bacterial foodborne disease outbreaks: 82 reports (1986-1995).* J Am Vet Med Assoc. 1998; 212(12) : 1874-81.p Abstract: OBJECTIVE: To examine the study design of, and the practice of causal inference in, investigations of bacterial foodborne disease outbreaks occurring in the United States and to summarize agents and vehicles identified. DESIGN: Retrospective study. PROCEDURE: An online medical reference database was searched for reports of bacterial foodborne disease outbreak investigations published between 1986 and 1995. Reports were retrieved and reviewed for use of 9 causal criteria in investigations. Information on etiologic agents, vehicles, seasonality, and primary study design from each outbreak was also retrieved. RESULTS: 82 reports were retrieved and reviewed. Coherence, consistency, temporality, and strength of association were the causal criteria most commonly used in foodborne disease outbreak investigations. Coherence was used in all investigations. The number of criteria used ranged from 3 to 7. Meat (n = 20) and eggs (12) were the most commonly implicated vehicles. Salmonella sp and Escherichia coli O157:H7 accounted for 55% of agents reportedly isolated. Cohort and case-control methods were the most common study designs. CLINICAL RELEVANCE: Patterns were found in the use of causal criteria in foodborne disease outbreak investigations. These criteria can provide veterinarians and other public health practitioners with a means to effectively conceptualize, communicate, and summarize causal conclusions. The 4 most commonly used criteria may represent core criteria that investigators consider most useful in explaining food-borne disease outbreaks.

Pierre V. et al. *[In Process Citation].* Bull Acad Natl Med. 2000; 184(2) : 295-302; discussion 302-3.p Abstract: Listeriosis is a rare but very serious foodborne disease. The non-contamination of food products is the best prevention of listeriosis. In spite of notable efforts to improve the microbiologic quality of food products through surveillance and control of food contaminations, the prevention has still to be based upon the information of consumers. This information can take different forms. When a food product is found to be contaminated with Listeria monocytogenes, if the withdrawal of this product does not occur as early as to prevent its commercialisation, a consumers alert is necessary to avoid any subsequent human case and to allow a rapid medical care of exposed persons in case of occurrence of symptoms of the disease. A specific information from health professionals to persons with risk factors of contracting listeriosis is a point of debate. Immunocompromised persons, for instance do not represent an easily defined group. On the other hand, pregnant women that are specially at risk of developing listeriosis, with potentially life threatening consequencies for their foetus, represent a well identified population. They are medically monitored, and, because they feel concerned, most of them accept, during their pregnancy, to follow some simple rules that, sometimes, change their habits. At present, information is given to pregnant women by different ways: documents, leaflets, posters. The health authorities have decided to reinforce this information. They are also working on a special advisory meeting, specially targeted at foodborne diseases (including listeriosis), that could take place, for pregnant women, during the first months of their pregnancy.

Pinner R.W. *Addressing the challenges of emerging infectious disease.* Am J Med Sci. 1996; 311(1) : 3-8.p Abstract: Through the recent examples of diphtheria in the former Soviet Union, plague in India, and trends in pneumonia mortality in the United States, the author, in this article, illustrates issues in emerging infectious diseases. The Centers for Disease Control's plan, Addressing Emerging Infectious Disease Threats: A Prevention Strategy for the United States, is summarized. Initial efforts to implement this plan are described, with particular focus on the development of Emerging Infections Programs, which are conducting epidemiologic and laboratory projects on several infectious diseases, including invasive bacterial diseases, unexplained deaths, foodborne diseases, and ehrlichiosis in four population-based sites in the United States.

Plaut A.G. *Clinical pathology of foodborne diseases: notes on the patient with foodborne gastrointestinal illness.* J Food Prot. 2000; 63(6) : 822-6.p Abstract: The symptoms and signs in persons with food- or waterborne infections provide clues to the nature of the infecting microbe. Proper treatment of the affected individual, and protection of those exposed to the same source, is dependent on time-honored methods of diagnosis: exposure history, and physical examination. Laboratory testing may help to identify the responsible agent. Spontaneous recovery is the most likely outcome once supportive measures such as fluid and electrolyte replacement are addressed. Antibiotics are often unnecessary and may prolong fecal excretion of certain microorganisms. In immunosuppressed persons or those weakened by marginal nutrition, foodborne infection can be more severe, mandating more specific therapy. Management requires knowing the level of tissue invasion and organ infected by each of the commonly encountered microbes. Some of the most life-threatening infections (cholera, for example) are associated with no visible tissue injury, yet they have a profound impact on gut function. In contrast, salmonellosis and shigellosis can cause severe gut injury, and when foodborne infections extend beyond the confines of the gut, skilled care is essential. Examples are

hemolytic uremic syndrome of Escherichia coli infections, or listeriosis, both of which require urgent attention. Long-term consequences of gut infections such as the paralytic Guillain-Barre syndrome following Campylobacter infections illustrates the long-term problems sometimes encountered. Because it is unlikely that all infectious agents will ever be removed from food and water in any country, sound medical intervention tailored to the extent of illness will be the mainstay of handling such illnesses.

Ploeg A.T. et al. *Susceptibility of transgenic tobacco plants expressing tobacco rattle virus coat protein to nematode-transmitted and mechanically inoculated tobacco rattle virus.* J Gen Virol. 1993; 74 (Pt 12) : 2709-15.p Abstract: Transgenic Samsun NN tobacco plants expressing the coat protein of tobacco rattle virus were exposed to mechanical leaf inoculation with tobacco rattle virus and to viruliferous trichodorid vector nematodes. Whereas plants were resistant to mechanical inoculation the vector nematodes successfully transmitted tobacco rattle virus to the roots as well as to the leaves of these plants. It is suggested that transgenic resistance is overcome either because vector nematodes inject relatively large numbers of virus particles into a cell or because they inject destabilized particles. The results indicate that coat protein-mediated resistance is unlikely to be of value for controlling tobacco rattle virus in field crops.

Pointon A.M. et al. *Risk assessment of organoleptic postmortem inspection procedures for pigs.* Vet Rec. 2000; 146(5) : 124-31.p Abstract: A systematic quantification of foodborne hazards in abnormal and normal tissues of pig carcases was undertaken to provide a risk-based assessment of the effectiveness of traditional organoleptic meat inspection. A total of 36,059 pigs, representing all major pig-producing areas and systems in Australia, were inspected on a seasonal basis at three abattoirs over 12 months. The prevalence of grossly detectable abnormalities of possible food-borne disease significance was recorded. A subset of the grossly detectable abnormalities, together with tissues classified by inspection as normal (controls) were submitted for the detection of a broad range of food-borne hazards. The potential exposure of consumers to hazards in fresh pork was characterised as the number of carcases per 10,000 containing hazards in selected tissues. The results indicated that the level of exposure of consumers to microbiological hazards in fresh pork is unlikely to be reduced significantly by the detection and removal of gross abnormalities in the tissues examined. On the basis of carcase throughput, the rate of contamination of normal lymph nodes was commonly 100 times higher, and no hazards were isolated from two types of grossly abnormal nodes. While further processing, cooking and handling may alter the exposure characterisation, the study nevertheless identifies the proportional contribution of abnormal and normal tissues to risks to consumers and clearly identifies the need for consideration of 'visual only' inspection in the re-evaluation of traditional inspection procedures.

Pontello M. et al. *[Foodborne diseases: a survey on working methods used by 6 Public Health Services in the Lombardy Region. 1. Outbreaks (published erratum appears in Ann Ig 1996 May-Jun;8(3):409)].* Ann Ig. 1995; 7(5) : 369-81.p Abstract: Since foodborne diseases, especially those caused by bacteria, have become an increasingly important public health problem, the Authors conducted a survey in order to evaluate the organization of, and the intervention carried out by, six Public Health Services in the Lombardia region, after reports of foodborne diseases outbreaks. Lack of correct methodology was detected, not to mention the usual omission of epidemic curves and attack rates. Besides, too many microbiological tests were made and it took too much time to take care of and to report the outbreaks to Regional and National Health Authorities. Forty-one outbreaks were examined: 415 cases occurred (AR: 28.7%), most of which home-made food-related. In 25 outbreaks the suspected food vehicles were eggs or fish, but only 5 of them were confirmed by laboratory tests. Salmonella enterica, either serovar Eenteritidis or group D, appeared responsible for 26 of the outbreaks [corrected].

Popovic T. et al. *Epidemiologic application of a standardized ribotype scheme for Vibrio cholerae O1.* J Clin Microbiol. 1993; 31(9) : 2474-82.p Abstract: A standardized scheme of 27 different BglI ribotypes and subtypes of Vibrio cholerae O1 strains is proposed on the basis of data from 214 human and environmental strains isolated in 35 countries and 14 U.S. states over the past 60 years. The ribotype patterns obtained are reproducible and stable over time. Seven different but very similar ribotypes (1a to 1g) were observed among 16 strains of the classical biotype. Twenty ribotypes and subtypes were identified among 198 V. cholerae O1 strains of the El Tor biotype. Six different patterns were found among the strains causing the current seventh pandemic. Strains of ribotype 8 originated only in central African countries, while those of ribotype 3 originated mainly in Asia and the Pacific Islands. The most widely distributed strains were those of ribotype 6, which was subdivided into three very similar but still distinguishable subtypes. The present Latin American epidemic is caused by strains of ribotype 5. Strains of this ribotype were isolated from several other geographic locations but can be differentiated from the Latin American strains by other molecular methods. Strains associated with two documented environmental reservoirs exhibited three distinct ribotype patterns; those isolated from patients who ate food from the U.S. Gulf waters were all of ribotype 2, while the strains related to the northeast Australian rivers were of ribotypes 9 and 10. Nontoxigenic V. cholerae O1 strains originating in Latin America and the U.S. Gulf Coast did not form a specific cluster of ribotypes.(ABSTRACT TRUNCATED AT 250 WORDS).

Potter M.E. et al. *Epidemiology of foodborne diseases: tools and applications.* World Health Stat Q. 1997; 50(1-2) : 24-9.p Abstract: Food safety is a complex matter that depends on a number of interrelated environmental, cultural, and socioeconomic factors. The purpose of epidemiology and surveillance is to define these factors,

how they interact, and their relative importance in foodborne infections. The tools epidemiologists use to study foodborne disease include surveillance of specific infections in humans, monitoring of contamination with specific pathogens in foods and animals, intensive outbreak investigations, collecting reports of outbreaks at the regional or national level, and studies of sporadic infections. With sufficiently elaborate systems of surveillance and investigation, it is possible to provide quantitative risk data for foodborne diseases that will permit the wisest allocation of food safety resources.

Powell S.C. et al. *The use of epidemiological data in the control of foodborne viruses.* Rev Environ Health. 1999; 14(1) : 31-7.p Abstract: The Codex Committee on Food Hygiene has recommended the adoption of Hazard Analysis and Critical Control Point (HACCP) as the basis for food safety control. To provide an objective basis for the construction of HACCP systems, epidemiological data are required. The data should be accurate, up-to-date, and identify emerging pathogens, such as viruses. The number of laboratory reports of small, round-structured viruses in England and Wales has increased from 400 cases in 1990 to 2387 in 1996. Although a food vehicle is not essential for the spread of viral particles, food my be the primary unidentified vehicle. The Advisory Committee on the Microbiological Safety of Foods recommends the use of the Kaplan Criteria, which can give strong circumstantial evidence that an outbreak is attributable to small, round-structured viruses. The application of these criteria would give a more accurate reflection of the involvement of viruses in the incidence of foodborne disease. This review considers the use of epidemiological data to support HACCP and risk-assessment systems. It discusses the implications of focusing on traditional pathogens, for example Salmonella spp., as opposed to emerging pathogens, for the design of control systems. Recommendations are made for improving the system of data collection.

Powell S.C. et al. *A comparative study of food retail premises by means of visual inspection and microbiological quality of food.* Epidemiol Infect . 1995; 114(1) : 143-51.p Abstract: The relationship between visual inspection ratings given to ten food retail premises and the microbiological quality of food samples was examined. Viable counts of bacteria and of Staphylococcus aureus were determined for cooked meat samples from each of the premises. There was no correlation between potential risk of foodborne infection, as assessed by total inspection rating, and bacteriological counts in food ($P < 0.05$). Neither was there a consistent relationship between scores given to any component of the total rating and the bacteriological quality of food. The effectiveness of the current UK inspection scheme in assessing risk of foodborne infection is questioned. Inclusion of appropriately weighted criteria such as food temperature abuse is suggested to improve the scheme.

Prier R. et al. *Foodborne and waterborne infectious diseases. Contributing factors and solutions to new and reemerging pathogens.* Postgrad Med. 2000; 107(4) : 245-52, 255.p Abstract: Demographic changes and complexities in food production, combined with complacency about the role of infectious diseases in general and the safety of the US food supply in particular, have brought about a resurgence in foodborne and waterborne infectious diseases and, with it, challenges that are unprecedented in recent times. A vigorous effort is already under way to ensure that food and water supplies are safe. This renewed attention to food and water safety must not be an interim response to a perceived short-term threat but, rather, a long-term effort to protect the population from pathogenic microorganisms whose wily adaptations will require constant vigilance.

Przybylska A. *[Foodborne infections and food poisoning in 1997].* Przegl Epidemiol. 1999; 53(1-2) : 103-14.p Abstract: In total were registered 27,922 cases of foodborne infections and intoxications in 1997 (salmonelloses of animal source, staphylococcal, botulism, other bacterial and caused by undetermined agents). Morbidity amounted 72.7/100,000. In 274 outbreaks of collective illnesses (4 people and more) 4,817 cases were registered altogether. Salmonella enteritidis caused 95.5% causes in outbreaks. The main vehicle of foodborne infections and intoxications in outbreaks was food prepared from raw materials of animal source, which caused 91.2% cases in outbreaks, in which dishes from eggs brought about 47.4% of these cases. Among the places of the ready made food production, private homes prevailed (57.9% of the whole amount of outbreaks). There epidemics numbering above 100 cases each were registered in 1997.

Przybylska A. *[In Process Citation].* Przegl Epidemiol. 2000; 54(1-2) : 103-14.p Abstract: In total were registered 30,515 cases of bacterial foodborne infections and intoxiations (salmonelloses of animal source, staphylococcal, botulism, other bacterial and caused by undetermined agents) in 1998. Morbidity amounted 78.9/100,000. In 399 outbreaks of collective illnesses (4 people and more) 8225 cases were registered altogether. S. Enteritidis caused 92.5% cases in outbreaks. The main vehicle of foodborne infections and intoxications in outbreaks was food prepared from raw materials of animal source, which caused 86.8% cases in outbreaks. Dishes from eggs brought about 45.5% of these cases. Among the places of the ready made food production, private homes prevailed (58.1% of the whole amount of outbreaks). Seven epidemics numbering above 100 cases each were registered in 1998.

Przybylska A. *[Outbreaks of foodborne diseases of bacterial etiology in Poland in 1990-1996].* Przegl Epidemiol. 1998; 52(3) : 269-74.p Abstract: The domination of salmonellas of animal's source remains in Poland in 1990-1996 in outbreaks (from 84.4% to 95.8%), despite the decreasing of the yearly numbers of diseases caused by foodborne and waterborne infections and intoxications. Participation of the

S. enteritidis among salmonellas of animal's source amounted from 92.6% to 97.8%. The most cases in the total number of diseases in outbreaks occurred after eating of the dishes made from eggs (from 41.8% to 54.9%). Food prepared in private homes contributed to the occurrence of the outbreaks to the highest degree (from 61.1% to 74.3%). The private homes were also the most frequent places of the consumption of those dishes. It results from the epidemiological data that raw materials (mainly eggs) coming from private farms contributed to the contamination of ready food to a high degree.

Przybylska A. *[Registration of the foodborne diseases in Poland in 1919-1997].* Przegl Epidemiol. 1998; 52(3) : 263-7.p Abstract: The aim of this paper was presenting of the history of registration of the foodborne and waterborne diseases in Poland, as well as describing of the epidemiological situation of these diseases. In the years between the I and II World Wars and from 1945 to 1947 enteric fever and bacterial dysentery were most often registered. From 1951 began the increasing of the total numbers of cases of the viral hepatitis with the peak of diseases in 1964 (about 125,000 cases). The years 80s were characterized by the increasing number of cases caused by Salmonella of animal's source with the peak in 1988 (about 62,000 cases). In the years 90s the decrease of the number of salmonelloses of animal's source occurred.

Przybylska A. et al. *[Elaboration and examination of the functioning of a new system for collection and analysis of information on foodborne and waterborne diseases in Poland].* Przegl Epidemiol. 1992; 46(4) : 335-43.p Abstract: During 1986-1989 the new computerized system of collection and analysis of foodborne and waterborne infections and intoxications (based on the proposition of World Health Organization) was developed in the Department of Epidemiology of the National Institute of Hygiene in Warsaw. System consists of the new forms (including computer's form) and adapted original programming. The new forms were officially introduced by the Ministry of Health and Welfare for the use by the all Sanitary Stations in Poland from the beginning of 1991. That system was served to present data on epidemiological situation of foodborne and waterborne infections and intoxications in Poland in 1988-1991, demonstrated in the paper. Criteria of analysis were adapted to meet conditions of the international cooperation, and-first of all-to the requirements of Polish epidemiological situation.

Q

Quiroz E.S. et al. *An outbreak of cryptosporidiosis linked to a foodhandler.* J Infect Dis. 2000; 181(2) : 695-700.p Abstract: In September and October 1998, a cryptosporidiosis outbreak occurred on a Washington, DC, university campus. In a case-control study of 88 case patients and 67 control subjects, eating in 1 of 2 cafeterias was associated with diarrheal illness (P<.001). Morbidity was associated with eating dinner on 22 September (odds ratio, 8.1; 95% confidence interval, 3.4-19.5); weaker associations were found for 6 other meals. Cryptosporidium parvum was detected in stool specimens of 16 (70%) of 23 ill students and 2 of 4 ill employees. One ill foodhandler with laboratory-confirmed C. parvum prepared raw produce on 20-22 September. All 25 Cryptosporidium isolates submitted for DNA analysis, including 3 from the ill foodhandler, were genotype 1. This outbreak illustrates the potential for cryptosporidiosis to cause foodborne illness. Epidemiologic and molecular evidence indicate that an ill foodhandler was the likely outbreak source.

R

Raghavan V.S. et al. *Comparison of various diagnostic methods in characterizing Newcastle disease virus isolates from Desi chickens.* Trop Anim Health Prod. 1998; 30(5) : 287-93.p Abstract: Eleven Newcastle disease viruses (NDV), isolated from apparently healthy and ailing Desi chickens were subjected to both conventional and modern characterization techniques. The virulence and strain differentiating experiments placed 10 isolates in the velogenic group and one in the mesogenic group. In MDBK cells, 9 isolates produced characteristic cytopathogenic effects up to 5 and 2 up to 3 passages. Molecular characterization with a 21-mer oligonucleotide probe placed all the isolates in the velogenic/mesogenic group. The results of this study clearly indicated that the isolates obtained are either velogenic or mesogenic but not lentogenic.

Rajendran R. et al. *Binding of heterocyclic amines by lactic acid bacteria from miso, a fermented Japanese food.* Can J Microbiol. 1998; 44(2) : 109-15.p Abstract: Miso, a widely used Japanese fermented food was analysed for its lactic acid bacterial count on bromocresol purple agar. The binding of eight different foodborne carcinogenic heterocyclic amines to 25 bacterial isolates from miso were investigated. The heterocyclic amines used were 3-amino-1,4-dimethyl[5H]pyrido(4,3-b)indole (Trp-P-1), 3-amino-1-methyl[5H]pyrido(4,3-b)indole (Trp-P-2), 2-amino-6-methyldipyrido(1,2-a:3'2'-d)imidazole (Glu-P-1), 2-amino-1-methyl-6-phenylimidazo(4,5-b)pyridine (PhIP), 2-amino-dimethylimidazo(4,5f)quinoline (IQ), 2-amino-3,4-dimethylimidazo(4,5-f) quinoline (MeIQ), 2-amino-3,8-dimethylimidazo(4,5-f)quinoxaline (MeIQx), and 2-amino-3-methyl-9H-pyrido(2,3)indole (MeA alpha C). The lyophilized cells of all of the isolates exhibited high binding activity towards Trp-P-1, Trp-P-2, MeA alpha C, and PhIP, while Glu-P-1 and IQ were not effectively bound. Of the isolates tested, the strongest and weakest binders were identified as Pediococcus acidilactici 1 and 2, respectively. Lyophilized cell wall fractions, heat-treated cells, and the cytoplasmic contents of P. acidilactici 1 and 2 were analysed for their ability to bind to different mutagens. Pure cell wall and peptidoglycan showed greater binding activity than the bacterial cells. Cytoplasmic content also showed some binding, but it was much less

effective. The impact of enzymes (amylase, protease, cellulase, chitinase, muraminase, and peptidase) and acetylation of Trp-P-1 and IQ on the binding action of bacteria and cell wall material were also analysed to understand the possible processes involved in the binding of lactic acid bacteria to carcinogenic heterocyclic amines.

Ramos M. et al. *Reduction of endogenous bacteria associated with catfish fillets using the Grovac process.* J Food Prot. 2000; 63(9) : 1231-9.p Abstract: Fresh catfish (Ictalurus punctatus) fillets are known to be contaminated with a large number of spoilage and pathogenic bacteria. The Grovac method, a new patented (U.S. 5,543,163) process, was evaluated for its efficacy in reducing the number of pathogens and spoilage microorganisms associated with food. This process involves using a processing solution containing ascorbic acid (AA) and sodium chloride (NaCl), vacuum, and tumbling. A total of 51 bacterial isolates were isolated and identified from whole catfish and catfish fillets using both selective and nonselective media, phenotypic tests, and the Vitek identification system. Psychrotrophic foodborne pathogens included: Aeromonas hydrophila, Escherichia coli, Listeria sp., Plesiomonas shigelloides, Proteus sp., Staphylococcus aureus, and Vibrio parahaemolyticus. High aerobic plate counts (2.6 x 10(7) CFU/g) for catfish fillets indicated that fillets were heavily contaminated during processing of catfish. The Grovac process showed that various treatment combinations of AA and NaCl resulted in a 1.2 to 2.3 CFU/g log reduction of microbial counts associated with catfish fillets. The effectiveness of the process may be related to the synergistic effect of tumbling, AA, NaCl, and vacuum. These results suggested that the Grovac process could be used as an alternative processing procedure to reduce microbial populations associated with catfish fillets and may be useful to improve the shelf-life and food safety of the product. Microbiological data from this study will be used for the development of a hazard analysis for the implementation of the hazard analysis critical control point program for processed catfish fillets.

Ramos-Nino M.E. et al. *QSARs for the effect of benzaldehydes on foodborne bacteria and the role of sulfhydryl groups as targets of their antibacterial activity.* J Appl Microbiol. 1998; 84(2) : 207-12.p Abstract: Quantitative structure activity relationships (QSARs) were obtained describing the activity of a series of benzaldehydes against three different foodborne bacteria, Listeria monocytogenes F6861, serotype 4b, Salmonella enteritidis, Phage type 4, P167807 and Lactobacillus plantarum INT.L11. MIC values at pH 6.2 and 35 degrees C were obtained for 11 phenolic benzaldehydes to produce multiple linear regression and artificial neural network models. For each organism, the models contained a steric parameter Vw and an electronic-steric parameter for ortho substituents Es degree. The benzaldehydes did not require to partition to produce their effect, shown by the lack of a lipophilic parameter in the models. This strongly suggests that they act on the outside of the cells. Substitution ortho to the carbonyl group increased their antibacterial action. Cells were treated with 2,3-dihydroxy benzaldehyde and examined for their ability to bind radiolabelled iodoacetate to envelope sulfhydryl groups that remained available. It was shown that the accumulation of radiolabelled iodoacetate was lower after treatment, indicating possible competition between these two compounds for the same target. The order of the sensitivity to benzaldehydes (Salmonella > Listeria > Lactobacillus) correlated with the number of surface sulfhydryl groups available, being highest for Salmonella.

Rasmussen M.A. et al. *Rumen contents as a reservoir of enterohemorrhagic Escherichia coli.* FEMS Microbiol Lett. 1993; 114(1) : 79-84.p Abstract: We investigated the role of the rumen fermentation as a barrier to the foodborne pathogen, Escherichia coli O157:H7. Strains of E. coli, including several isolates of O157:H7, grew poorly in media which simulated the ruminal environment of a well-fed animal. Strains of E. coli O157:H7 did not display a superior tolerance to ruminal conditions which may facilitate their colonization of the bovine digestive tract. Unrestricted growth of E. coli was observed in rumen fluid collected from fasted cattle. Growth was inhibited by rumen fluid collected from well-fed animals. Well-fed animals appear less likely to become reservoirs for pathogenic E. coli. These results have implications for cattle slaughter practices and epidemiological studies of E. coli O157:H7.

Ravishankar S. et al. *Acid adaptation of Listeria monocytogenes strains does not offer cross-protection against an activated lactoperoxidase system.* J Food Prot. 1999; 62(6) : 670-3.p Abstract: Listeria monocytogenes has been implicated in foodborne illness outbreaks involving several types of cheeses made from acidified milk. Acid shock response (ASR) and acid tolerance response (ATR) could be possible reasons for its survival. The ASR and ATR of three strains of L. monocytogenes (V7, V37, and CA) in skim milk acidified to pH 4.0 and 3.5 with lactic acid and held at 32 degrees C were studied. Studies were also done to determine if acid adaptation of the organism enhanced survival in the presence of an activated lactoperoxidase system. The cells were directly shocked at pH 4.0 and 3.5 in skim milk to study the ASR. To study the ATR, cells were initially adapted in skim milk at a mild pH of 5.5 for the equivalent of one generation before being shocked at pH 4.0 and 3.5 in skim milk. Cells adapted at pH 5.5 in tryptic soy broth without dextrose and nonadapted cells were challenged at pH 4.5 in skim milk with or without an activated lactoperoxidase system. In all cases, viability and pH were measured 24 or 48 h after challenge. In pH 4.0 skim milk, for all three strains, the adapted cell population survived better (0.5 to 1.0 log higher) than that of nonadapted cells for 24 h. In pH 3.5 skim milk, the acid-adapted populations of all three strains were 3 to 4 logs greater than those of nonadapted cells at 6 h. The acid adapted cells of all three strains had survival rates similar to those of the nonadapted cells at pH 4.5 both in the presence and absence of an activated lactoperoxidase system. It was also evident that these strains do not exhibit

an adaptive ATR at pH 4.5, although they do at lower pH levels (pH 4.0 and 3.5). Survival due to the ATR was better seen at pH 3.5 than at pH 4.0.

Reichart O. et al. *Mathematical modelling of the combined effect of water activity, pH and redox potential on the heat destruction.* Int J Food Microbiol. 1994; 24(1-2) : 103-12.p Abstract: Heat destruction of seven foodborne microorganisms (Lactobacillus plantarum, Lactobacillus brevis, Saccharomyces cerevisiae, Zygosaccharomyces bailii, Yarrowia lipolytica, Paecilomyces varioti and Neosartoria fischeri) as a function of the temperature, pH, redox potential and water activity was studied in synthetic heating media. Several mathematical models were developed for describing the heat destruction rate, most of them resulted in a good correlation between the fitted and measured values. The determination coefficients of the model-fitting were the best in case of lactobacilli and moulds (0.96-0.99) and the worst in case of the yeasts (0.81-0.88).

Reilly A. *Prevention and control of enterohaemorrhagic Escherichia coli (EHEC) infections: memorandum from a WHO meeting. WHO Consultation on Prevention and Control of Enterohaemorrhagic Escherichia coli (EHEC) Infections.* Bull World Health Organ. 1998; 76(3) : 245-55.p Abstract: Escherichia coli is a commonly occurring inhabitant of the intestine of humans and other animals, but there are several pathogenic types of E. coli which cause a variety of human diseases. One of these pathogenic types, E. coli O157:H7, belongs to the group of enterohaemorrhagic E. coli (EHEC) which produce potent toxins and cause a particularly severe form of disease, haemorrhagic colitis (HC). About 10% of patients with HC can go on to develop haemolytic uraemic syndrome (HUS), a life-threatening complication of E. coli O157:H7 infection that is characterized by acute renal failure, haemolytic anaemia, and thrombocytopenia. These sequelae are particularly serious in young children and older people. On average, 2-7% of patients with HUS die, but in some outbreaks among the elderly the mortality rate has been as high as 50%. This Memorandum reviews the growing importance of E. coli O157:H7 as a foodborne pathogen and reports on the issues of surveillance, outbreak investigation, and control strategies with respect to EHEC infections that were discussed at the WHO Consultation on Prevention and Control of EHEC Infections, held in Geneva on 28 April to 1 May 1997. Recommended measures for prevention and control include the following: use of potable water in food production; presentation of clean animals at slaughter; improved hygiene throughout the slaughter process; appropriate use of food processing measures; thorough cooking of foods; and the education of food handlers, abattoir workers, and farm workers on the principles and application of food hygiene.

Reina L.D. et al. *Inactivation of Listeria monocytogenes in milk by pulsed electric field.* J Food Prot. 1998; 61(9) : 1203-6.p Abstract: Pasteurized whole, 2%, and skim milk were inoculated with Listeria monocytogenes Scott A and treated with high-voltage pulsed electric field (PEF). The effects of milk composition (fat content) and PEF parameters (electric field strength, treatment time, and treatment temperature) on the inactivation of the bacterium were studied. No significant differences were observed in the inactivation of L. monocytogenes Scott A in three types of milk by PEF treatment. With treatment at 25 degrees C, 1- to 3-log reductions of L. monocytogenes were observed. PEF lethal effect was a function of field strength and treatment time. Higher field strength or longer treatment time resulted in a greater reduction of viable cells. A 4-log reduction of the bacterium was obtained by increasing the treatment temperature to 50 degrees C. Results indicate that the use of a high-voltage PEF is a promising technology for inactivation of foodborne pathogens.

Rhodehamel E.J. et al. *Sodium hypophosphite inhibition of the growth of selected gram-positive foodborne pathogenic bacteria.* Int J Food Microbiol. 1990; 11(2) : 167-78.p Abstract: Sodium hypophosphite (SHP) was evaluated for inhibition of growth of selected Gram-positive foodborne pathogenic bacteria in Trypticase Soy Broth. In addition, the effects of pH and sodium chloride (NaCl) alone and in combination with (SHP) were also examined. All inhibition studies were performed with optimal or nearly optimal growth conditions for each bacterium. Growth was monitored by determining culture optical density at 600 nm, and a time to significant growth determined for each test media. Ratios of time to significant growth for each control over that in test variables were used to evaluate the effect of SHP and other variables on growth. SHP was effective in inhibiting growth of Clostridium perfringens and Clostridium botulinum strains 62A 52A and Lamanna B, but generally ineffective against Staphylococcus aureus and Bacillus cereus. Results from this investigation show that SHP has potential as a food ingredient for the inhibition of certain Gram-positive foodborne pathogens.

Richards G.P. *Limitations of molecular biological techniques for assessing the virological safety of foods.* J Food Prot. 1999; 62(6) : 691-7.p Abstract: Enteric viruses, including hepatitis A, Norwalk, and Snow Mountain viruses, Hawaii agent, and rotaviruses have been associated with outbreaks of foodborne illness. Classical culturing procedures are available for poliovirus; however, hepatitis A, Norwalk, and many of the other viruses and agents cannot be propagated in cell culture, therefore, molecular biological tools have emerged as a possible means to detect enteric viruses in foods and environmental samples. There are limitations however in the application of polymerase chain reaction and reverse transcription polymerase chain reaction that restrict their usefulness for measuring the virological safety of foods. The most serious limitation is that molecular techniques fail to discriminate between viable and inactivated viruses even though inactivated viruses pose no threat to the consumer and may be present at levels substantially higher than the virulent forms. Other disadvantages include a lack of assay sensitivity and specificity, high assay costs, and a level of technical

expertise not available in most food-testing laboratories. Overall, scientific advances in the development of molecular biological tools have outpaced the demonstration of their validity in assessing the virological safety of foods.

Richards M.S. et al. *Investigation of a staphylococcal food poisoning outbreak in a centralized school lunch program.* Public Health Rep. 1993; 108(6) : 765-71.p Abstract: The trend in many communities toward centralized school lunch preparation potentially increases the risk of foodborne illness. Foods often are prepared long before serving and may be distributed to satellite schools by persons with little formal training in safe techniques of food preparation or food service. In May 1990, an outbreak of staphylococcal food poisoning occurred in elementary schools in a Rhode Island community participating in such a program. In the investigation of the outbreak, students in schools that reported cases were interviewed. Food preparation, handling, and distribution were reviewed. At School E, 662 lunches were prepared and distributed to 4 additional schools (schools A-D). Schools A and B accounted for nearly all cases of the food poisoning, with rates of 47 percent and 18 percent. Eating ham increased the risk of illness (62 percent of those consuming ham and 3 percent of those who did not, relative risk = 18.0, 95 percent confidence interval = 4.0, 313.4). Large amounts of Staphylococcus aureus were cultured, and preformed enterotoxin A was identified in leftover ham. A food handler, who tested positive for the implicated enterotoxic strain S. aureus, reported having removed the casings from two of nine warm ham rolls 48 hours prior to service. Because of improper refrigeration, prolonged handling, and inadequate reheating, the ham was held at temperatures estimated at 10-49 degrees Celsius (50-120 degrees Fahrenheit) for a minimum of 15 hours. The potential for larger outbreaks prompted a statewide training program in safe food preparation for school lunch personnel, which may have applications for other communities.

Ricke S.C. et al. *Conventional and molecular methods for understanding probiotic bacteria functionality in gastrointestinal tracts.* Crit Rev Microbiol. 1999; 25(1) : 19-38.p Abstract: The recent successes of probiotic application to limit colonization of foodborne pathogens in the gastrointestinal tracts of food animals ensures continued commercialization and widespread use of such cultures. Given that the the fermentation response and ecological balance of the probiotic consortium appears to be essential for the effectiveness of the cultures, it is essential to develop a methodology to accurately identify and quantitate these organisms during commercial production as well as successful in vivo colonization after administration. However, if further optimization of the effectiveness of defined cultures is to be achieved, methods to assess expression of key metabolic processes occurring during establishment of the probiotic culture as well as its subsequent ability to limit foodborne pathogen colonization are needed. Conventional methods to study individual probiotic gastrointestinal organisms include selective plating to identify specific nutritional groups, but the requirement of strict anaerobiosis for the obligate anaerobic members of these cultures can confound sample handling and preparation. Immunological methods can circumvent some of these problems but are somewhat limited for assessing functionality. The main advantage of using molecular tools is that the genetic diversity of the microflora, as well as their gene activity data are obtainable, both at the community level and at the single species level. Methods are currently available that permit studying individual members of microbial consortia, fluxes in community diversity, spatial distribution of consortia members, and the expression of specific microbial genes within communities. These methods involve the utilization of both DNA- and RNA-targeted probes, gene amplification protocols, and mRNA analysis. The study of mechanisms and functionality can only enhance the potential of probiotic cultures for limiting foodborne pathogen colonization.

Riedo F.X. et al. *A point-source foodborne listeriosis outbreak: documented incubation period and possible mild illness.* J Infect Dis. 1994; 170(3) : 693-6.p Abstract: Listeria bacteremia occurred in 2 pregnant women whose only common exposure was attendance at a party. The incubation period, the possibility of mild disease due to Listeria infection, and foods associated with risk of disease were evaluated. Ten (28%) of 36 party attenders met a case definition, which included isolation of Listeria monocytogenes from blood or stool or two of the following: fever, musculoskeletal symptoms, nausea, vomiting, diarrhea. One of 25 stool cultures was positive. The 2 blood isolates and 1 stool isolate were serotype 4b and identical by enzyme typing. The incubation periods for illness in the 2 pregnant women were 19 and 23 days. Consumption of large amounts of shrimp, nonalcoholic beverages, Camembert cheese, and cauliflower was significantly associated with illness. Eating shrimp remained a significant risk factor for illness after controlling for consumption of other foods. This study suggests a milder illness may exist in healthy persons who consume foods contaminated with L. monocytogenes and demonstrates a prolonged incubation period for disease.

Rijpens N.P. et al. *Simultaneous detection of Listeria spp. and Listeria monocytogenes by reverse hybridization with 16S-23S rRNA spacer probes.* Mol Cell Probes. 1995; 9(6) : 423-32.p Abstract: Enzymatic amplification results showed that Listeria species have at least two 16S-23S rRNA spacer regions of different lengths. These spacer regions of L. monocytogenes, L. ivanovii and L. seeligeri were cloned after enzymatic amplification. Sequence analysis of the inserts revealed two spacers of 245-246 bp and 496-498 bp, respectively, of which the latter included tRNA(Ala) and tRNA(Ile) genes. One Listeria spp.-specific probe, LIS-ICG4, was deduced from the 245-bp spacer and a L. monocytogenes-specific probe, LMO-ICG5, was inferred from the 496-bp spacer. The specificity of both probes was tested in a reverse hybridization assay (Line Probe Assay, LiPA). Both LIS-ICG4 and LMO-ICG5 proved to be highly specific when hybridized to a large

collection of Listeria strains and strains from other relevant taxa. The LiPA test herein described for the simultaneous detection of Listeria spp. and L. monocytogenes can be expanded to detect other foodborne pathogens.

Roberts R.B. *Emerging Pathogens Associated with Infectious Diarrhea.* Braz J Infect Dis. 1997; 1(4) : 153-176.p Abstract: In recent years, emerging microbial pathogens associated with infectious diarrhea have caused significant morbidity and mortality. Although sporadic cases of infectious diarrhea have occurred worldwide in the past, recent outbreaks in the United States traced to contaminated water or food have raised concerns about the safety of the water supply and the adequacy of surveillance of the food supply and foodborne diseases. In 1993, Cryptosporidium parvum, an important cause of unrelenting diarrhea and severe weight loss in AIDS patients, was associated with the largest outbreak of infectious diarrhea caused by contaminated municipal water that has ever been reported in the U.S. During the early summer of 1996, a major outbreak of Cyclospora cayetanensis that infected approximately 1,500 persons in 20 states, Washington, D.C. and two Canadian provinces was reported from North America. The suspected food vehicle in this outbreak was contaminated raspberries imported from Guatemala. In addition to these coccidian protozoa,Escherichia coli 0157:H7, first recognized in 1982 as a cause of hemorrhagic colitis, has recently been responsible for a multi-state outbreak in the U.S. due to contamination of commercial ground beef, and an outbreak in Japan that infected over 9,500 persons, two-thirds of whom were children. The contaminated food vehicle in the latter outbreak, although suspected to be radish sprouts, remains unknown. These recent massive outbreaks underscore the importance of a well-established public health infrastructure and an effective surveillance system for the early identification and reporting of infected patients that will lead to appropriate epidemiologic investigations and the rapid detection of contaminated vehicles.

Rocourt J. *[Listeriosis 1985-1995: microbiologic and epidemiologic aspects].* Bull Acad Natl Med. 1995; 179(8) : 1613-24.p Abstract: Listeriosis is an emerging foodborne infection caused by L. monocytogenes (L. m.), mainly identified in industrialized countries. It is a severe disease (meningitis, septicaemia, abortion) which preferentially affects individuals whose immune system is perturbed (pregnant women, newborns, immunocompromized patients and the elderly). Epidemiology is characterized by a background of sporadic cases on which may be surimposed outbreaks. Progresses in microbiology during the last decade (detection and typing of L. m., better understanding of L.m. ecology...) and epidemiological investigations (increased use of case-control studies) demonstrated that all kind of foods, at each step of the food chain, can transmit the disease. In many respects, L.m. differs from most recognized foodborne pathogens: it is ubiquitously present in nature, resistant to various kind of environments, microaerophilic and psychrophilic. Its tenacity in industrial environment and its capability to survive in food over extended period of time under adverse conditions made this bacterium the hottest topic for industrials during the last decade.

Rocourt J. et al. *Foodborne listeriosis.* World Health Stat Q. 1997; 50(1-2) : 67-73.p Abstract: Various epidemiological investigations of outbreaks and sporadic cases have clearly demonstrated that the consumption of contaminated food is responsible for a high proportion of listeriosis cases and Listeria monocytogenes has been increasingly recognized as an important foodborne pathogen over the last 15 years. The emergence of listeriosis is the result of complex interactions of different factors: medical progress which increases the lifespan and allows immunodeficient people to survive, expansion of the food industry and cold storage systems as well as changes in food habits. None of these factors on its own is entirely responsible. Considerable research has attempted to characterize the organism, define the magnitude of the public health problem and its impact on the food industry, identify the risk factors associated with the disease, and devise appropriate control strategies. Nevertheless, a number of crucial questions remains incompletely elucidated (extent of the foodborne transmission of listeriosis, health status of apparently "healthy patients" with the possible role of an intercurrent infection or genetic susceptibility, how to distinguish highly virulent from less virulent strains of L. monocytogenes, factors contributing to the emergence of outbreaks, the possible role of healthy carriers in the epidemiology of listeriosis, etc.). To investigate the complexity of listeriosis requires the close collaboration of clinicians, epidemiologists, clinical and food microbiologists, food scientists and the food industry. A large amount of data has been accumulated during the past 10 years but more research is required to elucidate the epidemiology of the disease and the virulence of the causative agent.

Rodrigue D.C. et al. *A university outbreak of Escherichia coli O157:H7 infections associated with roast beef and an unusually benign clinical course.* J Infect Dis. 1995; 172(4) : 1122-5.p Abstract: An outbreak of Escherichia coli O157:H7 infections occurred after a graduation banquet at a university in Wisconsin. Sixty-one (32%) of 193 banquet attendees developed a gastrointestinal illness; 2 were hospitalized, none developed hemolytic-uremic syndrome or thrombotic thrombocytopenic purpura, and none died. The spectrum of illness was unusually mild, with 61% of ill persons reporting nonbloody diarrhea. A strain of E. coli O157:H7, indistinguishable from the outbreak strain by toxin type, plasmid profile, and pulsed-field gel electrophoresis, was isolated from an unopened package of an uncooked round of beef from the original shipment of meat. An investigation suggested that both undercooked roast beef and salad cross-contaminated with beef were vehicles of transmission. These findings demonstrate that meat from beef cattle may transmit E. coli O157:H7, and such infections among young to middle-aged adults may be mild and may often go undetected.

Rodrigues A. et al. *Protection from cholera by adding lime juice to food - results from community and laboratory studies in Guinea-Bissau, West Africa.* Trop Med Int Health. 2000; 5(6) : 418-22.p Abstract: Epidemiological studies have shown that food plays an important role in the transmission of Vibrio cholerae, and different foods have been incriminated in many epidemic outbreaks of cholera. Storing contaminated meals at ambient temperatures allows growth of V. cholerae. Some ingredients such as lime juice may inhibit the survival of V. cholerae in foods. During an epidemic caused by V. cholerae O1 in Guinea-Bissau in 1996, a case control study was conducted in the capital Bissau, the main affected region with an attack rate of 7.4%. Cases were hospitalized patients and controls were matched for area, gender and age. Lime juice in the sauce eaten with rice gave a strong protective effect (odds ratio [OR] = 0.31, 95% confidence interval [CI] = 0.17-0.56), and tomato sauce was also protective (OR = 0.36, 95% CI = 0.24-0.54). On the other hand, use of a bucket for storage of water in the house was associated with increased risk (OR = 4.4, CI = 2.21-8.74). Laboratory experiments to elucidate the inhibitory effect of different concentrations of lime juice on survival of V. cholerae in meals showed that V. cholerae thrives in rice with peanut sauce, but lime juice inhibited its growth. Since lime juice is a common ingredient of sauces, its use should be further encouraged to prevent foodborne transmission in the household during cholera outbreaks.

Rodriguez-Romo L.A. et al. *Detection of enterotoxigenic Clostridium perfringens in spices used in Mexico by dot blotting using a DNA probe.* J Food Prot. 1998; 61(2) : 201-4.p Abstract: Several reports on the microbiology of spices and herbs indicate the presence of Clostridium perfringens, a spore-forming foodborne pathogen responsible for gastrointestinal disease. In the present study, a total of 380 samples of spices and herbs (cumin seed, black pepper, oregano, garlic powder, and bay leaves) widely used in Mexico were analyzed for the presence of C. perfringens, and the enterotoxigenicity of the isolates was determined by a dot-blot technique using an enterotoxin degoxigenin-labeled DNA probe. C. perfringens counts varied from <100 to 433 CFU/g in garlic powder, from <100 to 200 CFU/g in black pepper, from <100 to 433 CFU/g in cumin seed, from <100 to 340 CFU/g in oregano, and from < 100 to 450 CFU/g in bay leaves. The dot-blot technique detected the enterotoxin gene in 8 (4.25%) of 188 confirmed isolates of C. perfringens. dot-blot.

Roels T.H. et al. *Hepatitis A infections in Wisconsin: trends in incidence and factors affecting surveillance, 1986-1995.* WMJ. 1998; 97(5) : 32-8.p Abstract: From January 1986 through December 1995, 4,143 cases of hepatitis A virus (HAV) infection were reported in Wisconsin. The annual hepatitis A incidence remained stable from 1986 through 1988, with a mean annual rate of 4.7 cases per 100,000 (endemic HAV incidence rate). During 1989-1993, the incidence of HAV infection increased with a peak in 1992 of 19 cases per 100,000 population. A large foodborne outbreak (1992) and community wide outbreaks among African American residents (1989-1993) and Native Americans residents (1991) were associated with these high rates of HAV infection. The community wide outbreaks affected different groups: among African Americans, incidence rates were highest in young adults 15-34 years old; among Native Americans rates were highest in children 5-14 years old. Approximately 2,343 (57%) patients had no apparent risk factor (e.g., international travel, contact with person with HAV infection) for acquiring HAV infection. Factors limiting control of HAV infection in Wisconsin included poor reporting by laboratories (only 19% of all reported cases were independently reported to the Wisconsin Division of Health by a laboratory and fewer than 50% of these reports were from private laboratories), incomplete reporting by Wisconsin physicians or designees (74% of cases confirmed in Wisconsin laboratories were reported in 1995), failure to submit follow-up case report forms (14% of cases), and a prolonged interval between diagnosis and follow-up (> or = 15 days for 610 cases). Efforts should be enhanced to improve the reporting of cases of HAV infection by private laboratories, particularly through the use of automated electronic reporting.

Roels T.H. et al. *Incomplete sanitation of a meat grinder and ingestion of raw ground beef: contributing factors to a large outbreak of Salmonella typhimurium infection.* Epidemiol Infect. 1997; 119(2) : 127-34.p Abstract: Consumers in the United States continue to eat raw or undercooked foods of animal origin despite public health warnings following several well-publicized outbreaks. We investigated an outbreak of Salmonella serotype Typhimurium infection in 158 patients in Wisconsin during the 1994 Christmas holiday period. To determine the vehicle and source of the outbreak, we conducted cohort and case-control studies, and environmental investigations in butcher shop A. Eating raw ground beef purchased from butcher shop A was the only item significantly associated with illness [cohort study: relative risk = 5.8, 95% confidence interval (CI) = 1.5-21.8; case control study: odds ratio = 46.2, 95% CI = 3.8-2751]. Inadequate cleaning and sanitization of the meat grinder in butcher shop A likely resulted in sustained contamination of ground beef during an 8-day interval. Consumer education, coupled with hazard reduction efforts at multiple stages in the food processing chain, will continue to play an important role in the control of foodborne illness.

Roels T.H. et al. *A foodborne outbreak of Campylobacter jejuni (O:33) infection associated with tuna salad: a rare strain in an unusual vehicle.* Epidemiol Infect. 1998; 121(2) : 281-7.p Abstract: We report a foodborne outbreak of Campylobacter jejuni infection in a summer camp. Outbreak-related cases occurred in 79 persons including 3 secondary cases in campers. Campylobacter jejuni was isolated from stool specimens from 16 of 21 patients who submitted a sample; 13 viable isolates were serotyped and all were serotype O:33 (somatic O scheme) or HL:18 (heat-labile scheme), and biotype III (Lior scheme). This

serotype is widely distributed geographically but rarely isolated from humans. Samples of water from the wells supplying the camp were negative for faecal coliforms, and raw milk had not been served in the camp. A matched (1:1) case-control study identified tuna salad served for lunch on 19 July as the likely food item associated with illness (matched odds ratio=22; 95% confidence intervals (CI)=3.6-908). Swimming in the camp pool and other recreational water use in area lakes by the campers were not statistically associated with illness. The precise mechanism of introduction of the organism into the tuna salad remains unknown; contamination most likely occurred through cross-contamination with another food product, the hands of a food handler, or a work surface. Several deficiencies in the operation of the camp kitchen were identified. In Wisconsin, kitchens of such camps are subject to different inspection rules than restaurants. Camp staff, administrators, counselors, food managers, and infirmary staff, should fulfil important roles in their respective areas to prevent future outbreaks.

Rohm H. et al. *Evaluation of the API ATB 32C system for the rapid identification of foodborne yeasts.* Int J Food Microbiol. 1990; 11(3-4) : 215-23.p Abstract: The commercial API ATB 32C identification kit was compared with a standard method for identifying 11 reference strains and 53 yeast strains isolated from fermented milk products. Approx. 50% of the species considered in the API ATB 32C database were identified on a level of good, very good, and excellent identification. The numerical profile of 25 strains was not found in the API ATB 32C index. Low discrimination or misidentification was observed in seven strains. The low reliability of the API ATB 32C system may be ascribed to the incomplete nature of the profile index. A majority (91%) of the strains, however, were identified correctly by the API ATB 32C strip test results in combination with the commercial computer program of Barnett et al. (1985). This combined procedure offers the possibility to identify any out of 497 species considered by Barnett et al. (1985).

Rojas-Molina N. et al. *Gnathostomosis, an emerging foodborne zoonotic disease in Acapulco, Mexico.* Emerg Infect Dis. 1999; 5(2) : 264-6.p Abstract: Between 1993 and 1997, 98 gnathostomosis cases were clinically identified in Acapulco, Mexico. Intermittent cutaneous migratory swellings were the commonest manifestation. Larvae were identified in 26 cases, while in 72, final diagnosis was made on the basis of epidemiologic data, food habits, and positive enzyme-linked immunosorbent assay and Western blot results.

Rose J.B. et al. *Giardia, Cryptosporidium, and Cyclospora and their impact on foods: a review.* J Food Prot. 1999; 62(9) : 1059-70.p Abstract: While the risk from pathogenic microorganisms in foods has been recognized for hundreds of years, bacterial agents are generally implicated as the contaminants. Although many outbreaks of gastroenteritis caused by protozoan pathogens have occurred, it is only in the last 3 years that attention has focused on protozoan association with foodborne transmission. Recognized as waterborne parasites, Giardia, Cryptosporidium, and Cyclospora have now been associated with several foodborne outbreaks. The oocysts and cysts of these organisms can persist and survive for long periods of time both in water and on foods. While Cyclospora oocysts require a maturation period, Cryptosporidium oocysts and Giardia cysts are immediately infectious upon excretion from the previous host. As a result, these parasites have emerged as public health risks and have become a concern to the food industry. More than 200 cases of foodborne giardiasis (seven outbreaks) were reported from 1979 to 1990. Four foodborne Cryptosporidium outbreaks (with a total of 252 cases) have been documented since 1993. Cyclospora caused a series of sporadic outbreaks of cyclosporasis throughout North America that have affected over 3,038 people since 1995. Control and prevention of protozoan foodborne disease depends upon our ability to prevent, remove, or kill protozoan contaminants. This review will address the biology, foodborne and waterborne transmission, survival, and methods for detection and control of Giardia, Cryptosporidium, and Cyclospora.

Rosenfield S.I. et al. *A multiplex reverse transcription polymerase chain reaction method for the detection of foodborne viruses.* J Food Prot. 1999; 62(10) : 1210-4.p Abstract: A multiplex reverse transcription polymerase chain reaction (RT-PCR) method was developed for the simultaneous detection of the human enteroviruses, hepatitis A virus (HAV) and Norwalk virus (NV). Poliovirus type 1 (PV1) was chosen as a model for the human enterovirus group. Three different sets of primers were used to produce three size-specific amplicons of 435 bp, 270 bp, and 192 bp for PV1, NV, and HAV, respectively. RT-PCR products were separated by agarose gel electrophoresis, and amplicon identity was confirmed by Southern transfer followed by DNA hybridization using nonradioactive, digoxigenin-labeled internal probes. When tested on mixed, purified virus suspensions, the multiplex method achieved detection limits of < or = 1 infectious unit (PV1 and HAV) or RT-PCR-amplifiable unit (NV) for all viruses. With further streamlining efforts such as single tube amplification and liquid hybridization, multiplex PCR offers advantages over cell culture methodology and monoplex PCR because it allows for rapid and cost-effective detection of several human enteric viruses in a single reaction tube.

Rowan N.J. et al. *The bacteriological quality of hospital-prepared infant feeds.* J Hosp Infect. 1997; 35(4) : 259-67.p Abstract: Twenty-four pasteurized infant feeds, prepared in a Glasgow hospital, were examined microbiologically. All produced a satisfactory total aerobic mesophilic count of < or = 1.0 x 10(4) cfu/g (mean 6.3 x 10(1) cfu/g) within 1 h of preparation. Bacillus cereus was detected in two infant feeds immediately after preparation and one of these had a B. cereus count of 1.4 x 10(3) cfu/g exceeding the recommended safety limit of < or = 1.0 x 10(3) cfu/g. Subsequent storage over a 14 h period at 25

degrees C or greater resulted in the appearance of B. cereus in a further eight feeds, the majority of which exceeded the safety limit of 10(3) cfu/g. The microbiological quality of each infant feed depended on the type and number of organisms initially present, and on the temperature and duration of storage. Incubation of feeds at < or = 10 degrees C for 14 h did not alter the microbiological quality (P = 0.05). While Bacillus licheniformis and Bacillus subtilis were the predominant organisms isolated within 8 h of incubation (45.8 and 20.8% of feeds, respectively), additional storage resulted in the emergence of B.cereus I (25%) and II (20.8%) as dominant Bacillus spp. The addition of glucose polymers and other supplements to infant formulae did not affect the type and number of organisms present (P = 0.05). Diarrhoeal enterotoxin was detected in three of the five formulations which supported the growth of B. cereus II via the B. cereus enterotoxin reverse phase latex agglutination test BCET-RPLA system. Although the infant feeds were of similar microbiological quality (P = 0.05), the majority of Bacillus spp. isolated have been previously implicated in either foodborne illnesses and/or opportunist infections.

Russell J.B. et al. *Invited review: effects of diet shifts on Escherichia coli in cattle.* J Dairy Sci. 2000; 83(4) : 863-73.p Abstract: Escherichia coli O157:H7 is a pathogenic bacterium that causes acute illness in humans, but mature cattle are not affected. E. coli O157:H7 can enter the human food supply from cattle via fecal contamination of beef carcasses at slaughter. Previous attempts to correlate the incidence of E. coli O157:H7 with specific diets or feeding management practices gave few statistically significant or consistent findings. However, recent work indicates that cattle diets may be changed to decrease fermentation acid accumulation in the colon. When fermentation acids accumulate in the colon and pH decreases, the numbers of acid-resistant E. coli increase; acid-resistant E. coli are more likely to survive the gastric stomach of humans. When cattle were fed hay for a brief period (<7 d), acid-resistant E. coli numbers declined dramatically. Other workers have shown that brief periods of hay feeding can also decrease the number of cattle shedding E. coli O157:H7, and a similar trend was observed if cattle were taken off feed and exposed to simulated transport. These observations indicate that cattle feeding management practices may be manipulated to decrease the risk of foodborne illness from E. coli, but further work will be needed to confirm these effects.

Ryan M.J. et al. *Risk factors for outbreaks of infectious intestinal disease linked to domestic catering.* Commun Dis Rep CDR Rev. 1996; 6(13) : R179-83.p Abstract: The epidemiology of general outbreaks of infectious intestinal disease associated with domestic catering for large numbers is described and compared with foodborne outbreaks in other settings. From 1 January 1992 to 31 December 1994, the PHLS Communicable Disease Surveillance Centre identified 101 foodborne general outbreaks of infectious intestinal disease associated with domestic catering in England and Wales (16% of all foodborne outbreaks). Salmonella species were associated with 77 of the 101 outbreaks and S. enteriditis phage type 4 accounted for 57. Small round structured viruses were implicated in five outbreaks, Clostridium perfringens in four, Bacillus cereus in two, and Campylobacter sp and Escherichia coli in one each. No pathogen was identified in 11 outbreaks. Outbreaks occurred most commonly in summer. The commonest vehicles implicated were poultry/eggs in 44 outbreaks, desserts in 13, and meat/meat products in nine. Salad/vegetables, sauces, and fish/shellfish were each implicated in eight outbreaks. Raw shell eggs were implicated in a fifth of outbreaks. Inappropriate storage was the commonest fault, reported in association with 50 outbreaks (ambient temperature for long periods before serving in 29), inadequate heat treatment was reported in 35, cross contamination in 28, an infected food handler in 11, and other faults in 14. Outbreaks associated with catering on domestic premises were independently more likely than outbreaks in other settings to be associated with salmonellas, inappropriate storage of food, and consumption of poultry, eggs, or sauces. Public health services need to direct messages about the use, preparation, and storage of food to those who cater on domestic premises.

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Salamina G. et al. *A foodborne outbreak of gastroenteritis involving Listeria monocytogenes.* Epidemiol Infect. 1996; 117(3) : 429-36.p Abstract: An outbreak of gastroenteritis occurred in Italy among 39 persons who had attended a private supper. All guests were previously healthy, young, non-pregnant adults; 18 (46%) had symptoms, mostly gastrointestinal (78%), with a short incubation period. Four were hospitalized with acute febrile gastroenteritis, two of whom had blood cultures positive for Listeria monocytogenes. No other microorganisms were recovered from the hospitalized patients' specimens. Epidemiological investigation identified rice salad as the most likely vehicle of the food-borne outbreak. L. monocytogenes was isolated from three leftover foods, the kitchen freezer and blender. Isolates from the patients, the foods and the freezer were indistinguishable: serotype 1/2b, same phage type and multilocus enzyme electrophoretic type. Eight (36%) of 22 guests tested were found to have antibodies against L. monocytogenes, compared with none of 11 controls from the general population. This point source outbreak was probably caused by infection with L. monocytogenes. Unusual features included the high attack rate among immunocompetent adults and the predominance of gastrointestinal symptoms.

Salvat G. et al. *Control of Listeria monocytogenes in the delicatessen industries: the lessons of a listeriosis outbreak in France.* Int J Food Microbiol. 1995; 25(1) : 75-81.p Abstract: During a recent outbreak of foodborne listeriosis which occurred in France in 1992, investigations were carried out in order to identify the plants associated with the production of contaminated products. These

investigations were made in six 'suspect' delicatessen plants following the first epidemiological investigations, and in one 'control plant'. The first visits were made during working operations. Two hundred and seventy samples were taken ('environmental' swabs, air samples, products), with 68% of the swabs being positive for Listeria monocytogenes in raw product areas, and 33% positives in the finished product area. The epidemic phagovar was identified in a single plant preparing pork tongues in aspic. The major causes of contamination identified were contact of cooked products with soiled surfaces, cross-contamination between 'raw' and 'cooked' channels and the inadequacy of cleaning and disinfection procedures. A second visit was also made to five plants to provide validation of their cleaning and disinfection procedures. Among 112 swabs collected, 17% of the samples from raw product surfaces and 7% from finished product surfaces were found to be positive. These results suggest that cleaning and disinfection procedures were unable to eliminate sources of L. monocytogenes when not correctly applied.

Samadpour M. et al. *Molecular epidemiology of Escherichia coli O157:H7 strains by bacteriophage lambda restriction fragment length polymorphism analysis: application to a multistate foodborne outbreak and a day-care center cluster.* J Clin Microbiol. 1993; 31(12) : 3179-83.p Abstract: Genomic DNAs prepared from 168 isolates of Escherichia coli O157:H7 were analyzed for restriction fragment length polymorphisms on Southern blots probed with bacteriophage lambda DNA. The isolates analyzed included strains from a recent large multistate outbreak of E. coli O157:H7 infection associated with consumption of poorly cooked beef in restaurants, a day-care center cluster, and temporally and geographically unrelated isolates. E. coli O157:H7 isolates recovered from the incriminated meat and from 61 (96.8%) of 63 patients from Washington and Nevada possessed identical lambda restriction fragment length patterns. The lambda restriction fragment length polymorphisms observed in 11 (91.7%) of 12 day-care center patients were identical, but they differed from that of the strain associated with the multistate outbreak. E. coli O157:H7 from 42 patients temporally or geographically unrelated to either cluster of infection possessed unique and different lambda restriction fragment length patterns, except for paired isolates from three separate clusters of infection. These data demonstrate that the hybridization of DNA digests of E. coli O157:H7 with radiolabelled bacteriophage lambda DNA can be a useful, stable, and discriminatory epidemiologic tool for analyzing the linkage between strains of E. coli O157:H7.

Sarfati D. et al. *Acute gastroenteritis diagnostic practices of New Zealand general practitioners.* N Z Med J. 1997; 110(1052) : 354-6.p Abstract: AIMS: A sample of New Zealand general practitioners was surveyed to determine the laboratory referral practices of general practitioners for patients with acute gastroenteritis, with particular reference to viral gastroenteritis. METHODS: A mail questionnaire was sent to 209 general practitioners throughout New Zealand. RESULTS: The most important criteria for laboratory referral of a diarrhoeal specimen were prolonged duration of illness, presence of blood in the stool, a recent history of overseas travel, tramping or camping, shellfish consumption, or if the patient worked in the food, child care, or health care industries. Most general practitioners reported that they would refer diarrhoeal specimens from less than 25% of their patients with acute gastroenteritis. Requests for testing for viruses other than rotavirus were rare. CONCLUSION: The viral agents causing acute gastroenteritis were less likely to receive laboratory confirmation than other causes of gastroenteritis. On the basis of current laboratory investigation practices of general practitioners, foodborne viral gastroenteritis outbreaks are unlikely to be identified as such in New Zealand.

Schalch B. et al. *Ribotyping for strain characterization of Clostridium perfringens isolates from food poisoning cases and outbreaks.* Appl Environ Microbiol. 1997; 63(10) : 3992-4.p Abstract: Ribotyping was used to characterize 34 Clostridium perfringens strains isolated from 10 food poisoning cases and outbreaks over a 7-year period. Twelve different ribopatterns were generated by EcoRI digestion. In eight food poisoning cases and outbreaks, all of the ribotypes of each food and stool isolate were found to be identical. Two C. perfringens isolates showed unique patterns. Ribotyping was found to be a useful tool for determining the genetic relationship of C. perfringens isolates in the context of foodborne poisoning cases.

Scheule B. *Food-safety educational goals for dietetics and hospitality students.* J Am Diet Assoc. 2000; 100(8) : 919-27.p Abstract: OBJECTIVE: To identify food-safety educational goals for dietetics and hospitality management students. DESIGN: Written questionnaires were used to identify educational goals and the most important food safety competencies for entry-level dietitians and foodservice managers. SUBJECTS: The sample included all directors of didactic programs in dietetics approved by the American Dietetic Association and baccalaureate-degree hospitality programs with membership in the Council on Hotel, Restaurant, and Institutional Education. Fifty-one percent of the directors responded. STATISTICAL ANALYSIS: Descriptive statistics were calculated. chi 2 analysis and independent t tests were used to compare educators' responses for discrete and continuous variables, respectively. Exploratory factor analysis grouped statements about food safety competence. Internal consistency of factors was measured using Cronbach alpha. RESULTS: Thirty-four percent of dietetics programs and 70% of hospitality programs required or offered food safety certification. Dietetics educators reported multiple courses with food safety information, whereas hospitality educators identified 1 or 2 courses. In general, the educators rated food-safety competencies as very important or essential. Concepts related to Hazard Analysis and Critical Control Points (HAACP), irradiation, and pasteurization were rated less highly, compared with other items. Competencies related to reasons for outbreaks of foodborne illness were

rated as most important. APPLICATIONS/CONCLUSIONS: Food safety certification of dietitians and an increased emphasis on HAACP at the undergraduate level or during the practice component are suggested. Research is recommended to assess the level of food-safety competence expected by employers of entry-level dietitians and foodservice managers.

Scheuplein R.J. *Perspectives on toxicological risk--an example: foodborne carcinogenic risk.* Crit Rev Food Sci Nutr. 1992; 32(2) : 105-21.p Abstract: Epidemiologists estimate that approximately one third of all cancer deaths can be attributed to diet. It is instructive to attempt to apportion this dietary carcinogenic risk to the specific classes of foodstuffs and food additives, pesticides, etc., that are typically regulated. When this is done it is evident that virtually all the calculated risk can be attributed to naturally occurring carcinogens in the diet. This article indicates that both epidemiological data and the simplest kind of risk assessment agree that foodborne carcinogenic risk probably overwhelmingly originates from the food itself and not from additives, pesticides, or contaminants.

Schlech I.I.I. WF. *Foodborne listeriosis.* Clin Infect Dis. 2000; 31(3) : 770-5.p Abstract: Listeria monocytogenes emerged as an important foodborne pathogen in the latter part of the 20th century. Clinical syndromes caused by this microorganism include sepsis in the immunocompromised patient, meningoencephalitis in infants and adults, and febrile gastroenteritis. Focal infections at other sites are less frequent. Listeria species are commonly found in raw and unprocessed food products. Major outbreaks of listeriosis, with high morbidity and mortality, have been caused by a variety of foods, including soft cheeses, delicatessen meats, and vegetable products. Improved detection methods, dietary recommendations, and, in some cases, preemptive antibiotic treatment or prophylaxis have reduced the incidence of sporadic listeriosis infections in the United States. Microbial virulence factors distinguishing environmental strains of L. monocytogenes from invasive strains causing foodborne illness and host factors promoting human infection remain incompletely understood.

Schlech W.F. 3d. *An animal model of foodborne Listeria monocytogenes virulence: effect of alterations in local and systemic immunity on invasive infection.* Clin Invest Med. 1993; 16(3) : 219-25.p Abstract: Development of foodborne listeriosis is dependent on an interplay between organism-specific virulence factors and host susceptibility. Gastric inoculation of Sprague-Dawley rats was used as a model to explore Listeria-specific virulence and host susceptibility. Gastric inoculation leads to invasive infection with "smooth" hemolytic Listeria monocytogenes but not with "rough" L. monocytogenes or other Listeria species. Infection is dose-dependent with an ID50 of 10(6) virulent Listeria monocytogenes. In these experiments, the ID50 was not altered by pregnancy but invasive infection led to abnormal reproductive outcomes including stillbirth and reabsorption of fetuses. Immunosuppression by cyclosporin A led to more prolonged infection but did not alter the ID50. Manipulation of intestinal flora with antibiotics suggested increased rates of infection with antibiotics that decreased anaerobic flora. Growth of virulent Listeria in milk at varying temperatures did not enhance virulence. No differences in invasive potential of flagellated vs. non-flagellated L. monocytogenes were found. Oral models of invasive Listeria monocytogenes infection provide a useful tool for studying organism virulence and host susceptibility.

Schlech W.F. 3d. *Lowbury Lecture. Listeriosis: epidemiology, virulence and the significance of contaminated foodstuffs.* J Hosp Infect. 1991; 19(4) : 211-24.p Abstract: Recent epidemiological evidence confirms that sporadic, as well as outbreak-associated, cases of listeriosis are primarily foodborne in origin. Implicated foodstuffs include meat products, dairy products, fruit, seafood and raw and processed vegetables. Large community-acquired outbreaks in North America and Europe have been complemented by smaller outbreaks involving hospitalized patients. Anecdotal reports and case clusters of nosocomial cases also support foodborne transmission. Cross-infection may be a major mode of transmission as demonstrated in a recent outbreak in Costa Rica. The sporadic nature of outbreaks of listeriosis are more consistent with changes in organism virulence rather than host susceptibility. The population of patients at risk for listeriosis (pregnant women and immunocompromised hosts) may not vary greatly. Establishment of infection is probably dose-dependent and gastric acidity may be protective. However, other organism-specific virulence factors, such as haemolysin production, may affect the post-intestinal phase of infection. Virulence factors other than haemolysins have not been characterized as yet. In summary, acquisition of Listeria monocytogenes infection from the environment by susceptible hosts may be widespread but invasive infection remains rare and the determinants of invasion require further elucidation.

Schoeni J.L. et al. *Growth and penetration of Salmonella enteritidis, Salmonella heidelberg and Salmonella typhimurium in eggs.* Int J Food Microbiol. 1995; 24(3) : 385-96.p Abstract: Eggs and egg dishes are important vehicles for Salmonella infections. Salmonella enteritidis, Salmonella typhimurium and Salmonella heidelberg, which can be isolated from chicken ovaries and feces, have been implicated in approximately 50% of the foodborne salmonellosis outbreaks in the United States. In this study, the growth of these three organisms, inoculated into yolks and albumen, was compared at 4, 10 and 25 degrees C. Regardless of whether 10(2) cfu/g or 10(4) cfu/g was inoculated into the yolk or albumen, populations of all strains increased 3 logs or more in number in one day when incubated at 25 degrees C. Maximum numbers of Salmonella ranged from 10(8) to 10(10) cfu/g. All strains grew at 10 degrees C, but peak numbers were lower and occurred later than those at 25 degrees C. Populations of

the three Salmonella strains inoculated into eggs stored at 4 degrees C grew sporadically; in some test groups populations declined. The potential for Salmonella in contaminated feces to establish in the interior of eggs was examined by monitoring shell penetration. At 25 degrees C, all three Salmonella strains penetrated the shell in 3 days, but at 4 degrees C, only S. typhimurium was found in one membrane sample. When hatchery conditions were simulated by incubating eggs at 35 degrees C for 30 min followed by storage at 4 degrees C, penetration was enhanced. Penetration was observed by day 1-3 when eggs were exposed to 10(4) cfu Salmonella/g feces. Increasing the inoculum to 10(6) cfu/g feces resulted in 50-75% of the contents of eggs to be contaminated by day 1. All Salmonella-positive samples were detected by enrichment. Results of this study indicate that S. enteritidis, S. typhimurium, or S. heidelberg present in feces can penetrate to the interior of eggs and grow during storage.

Schuchat A. et al. *Role of foods in sporadic listeriosis. I. Case-control study of dietary risk factors. The Listeria Study Group.* JAMA. 1992; 267(15) : 2041-5.p Abstract: OBJECTIVE--To identify dietary risk factors for sporadic listeriosis. DESIGN--Case-control study with blinded telephone interviews. SETTING--Multistate population of 18 million persons, November 1988 through December 1990. PARTICIPANTS--One hundred sixty-five patients with culture-confirmed listeriosis and 376 control subjects matched for age, health care provider, and immunosuppressive condition. RESULTS--The annual incidence of invasive listeriosis was 7.4 cases per million population; 23% of the infections were fatal. Cases were more likely than matched controls to have eaten soft cheeses (odds ratio [OR], 2.6; 95% confidence interval [CI], 1.4 to 4.8; P = .002) or food purchased from store delicatessen counters (OR, 1.6; 95% CI, 1.0 to 2.5; P = .04); 32% of sporadic disease could be attributed to eating these foods. Sixty-nine percent of cases in men and nonpregnant women occurred in cancer patients, persons with the acquired immunodeficiency syndrome, organ transplant recipients, or those receiving corticosteroid therapy. Among these immunosuppressed patients, eating undercooked chicken also increased the risk of listeriosis (OR, 3.3; 95% CI, 1.2 to 9.2; P = .02). CONCLUSIONS--Foodborne transmission may account for a substantial portion of sporadic listeriosis. Prevention efforts should include dietary counseling of high-risk patients and continued monitoring of food production.

Schuchat A. et al. *Epidemiology of human listeriosis.* Clin Microbiol Rev. 1991; 4(2) : 169-83.p Abstract: During the 1980s, investigation of several large epidemics of listeriosis confirmed that transmission of L. monocytogenes in food causes human disease. Progress in laboratory detection and subtyping of the organism has enhanced our ability to compare human and environmental isolates of L. monocytogenes. Transmission by foodborne organisms is now recognized as causing both epidemic and sporadic listeriosis. Continued study of dietary risk factors associated with listeriosis is needed in order to develop dietary recommendations for the expanding population at increased risk of disease. Current research application of new molecular methods to the study of L. monocytogenes may improve the ability to diagnose pregnancy-associated disease and permit the rapid detection and control of L. monocytogenes in the food supply.

Sciacchitano C.J. et al. *Molecular detection of Clostridium botulinum type E neurotoxin gene in smoked fish by polymerase chain reaction and capillary electrophoresis.* J AOAC Int. 1996; 79(4) : 861-5.p Abstract: The polymerase chain reaction (PCR), a rapid, sensitive technique for amplifying target DNA sequences of pathogenic microorganisms, was used to amplify Clostridium botulinum type E neurotoxin gene fragments in smoked fish. Other botulinal neurotoxin-producing strains, nontoxigenic strains, and food-related microorganisms did not yield nonspecific amplification products with this PCR assay. PCR products were analyzed by capillary electrophoresis (CE) using a low-viscosity entangled polymer system. Resolution, sensitivity, and DNA sizing accuracy were improved, and analytical times were markedly shortened. The PCR/CE assay detected the C. botulinum type E neurotoxin gene in as few as 10 cells. The technique to other foods may also be a valuable tool for detecting foodborne pathogens.

Scott W.G. et al. *Economic cost to New Zealand of foodborne infectious disease.* N Z Med J. 2000; 113(1113) : 281-4.p Abstract: AIMS: To estimate the annual economic cost to New Zealand of foodborne infectious disease. METHODS: Annual incidence rates were combined with unit cost data to derive estimates of the annual economic cost to society of each foodborne infectious disease. Market prices and wages were used as proxies for the unit costs of resource utilisations. A decision analytic model was developed to estimate the costs of each disease and to undertake sensitivity analysis. RESULTS: There are an estimated 119 320 episodes of foodborne infectious disease per year in New Zealand (3241 per 100 000 population). The total cost of these cases was $55.1 million ($462 per case) made up of direct medical costs of $2.1 million, direct non-medical costs of $0.2 million, indirect cost of lost productivity of $48.1 million, and intangible cost of loss of life of $4.7 million. Campylobacteriosis generated most of the costs. Lost productivity was the major cost component for all diseases. The total cost of potentially foodborne infectious disease was estimated to be $88.8 million. Broad estimates of additional costs due to cases of infectious intestinal diseases caused by non-foodborne pathogens or for which no pathogen is identified could raise the cost to $215.7 million. CONCLUSION: The findings imply that resources of $55 million could be devoted to prevention of foodborne infectious disease. Efforts should focus on lowering the incidence of campylobacteriosis as this disease accounts for most of foodborne illness costs.

Scuderi G. et al. *Foodborne outbreaks caused by Salmonella in Italy, 1991-4.* Epidemiol Infect. 1996; 116(3) : 257-65.p

Abstract: This report summarizes studies on 1699 foodborne outbreaks, in Italy, reported to the Istituto Superior di Sanita (ISS) (the National Institute of Health of Italy, Rome) during the period 1991-4. The most frequently reported foodborne outbreaks were caused by salmonellae (81%), in particular by Salmonella enteritidis and non-serotyped group D salmonella (34% and 33% of the total salmonella outbreaks, respectively). A vehicle was implicated in 69% of the salmonella outbreaks; eggs were implicated in 77% of the outbreaks for which a vehicle was identified or suspected. Salmonella strains isolated in 54 outbreaks were studied for phenotypic and genotypic characteristics. The isolates belonged to S. enteritidis (50 outbreaks), S. typhimurium (three outbreaks) and S. hadar (one outbreak). In the S. enteritidis outbreaks, phage type 4 was most frequently isolated (64.8%), followed by phage type 1 (14.8%). The virulence plasmid of 38 megadaltons was found in many different phage types of S. enteritidis.

Seo K.H. et al. *Development of a rapid response biosensor for detection of Salmonella typhimurium.* J Food Prot. 1999; 62(5) : 431-7.p Abstract: An integrated optic interferometer for detecting foodborne pathogens was developed. The interferometer is a planar waveguide with two thin antibody-coated channels of immunochemically selective agents that interact with antigen molecules. One channel is coated with antibody to Salmonella as a sample, and the other is coated with human immunoglobulin G as a reference channel by using reductive amination. Salmonella was introduced onto the sensing channels through the flow cell on the channels. Phase shift (pi) generated by refractive index variation, as determined by interfering the perturbed sample channel with an unperturbed reference channel and observing the fringe shift, was used for detection. Salmonella Typhimurium (heat-treated or boiled) was detected by binding to antibody against Salmonella common structural antigen immobilized on a silane-derived sensor surface at concentrations in the range of 1x10(5) to 1x10(7) CFU/ml. Salmonella (1x10(7) CFU/ml) mixed with Escherichia coli (1x10(7) CFU/ml) were readily detected without any decrease in sensitivity by the direct assay. Application of a sandwich assay with a second antibody or a gold-conjugated antibody increased the detection limit to 1x10(5) CFU/ml within a 10-min reaction time. Various methods for the immobilization of the capture antibody to the biosensor channels were compared. The greatest binding response was observed in a direct reductive amination method with a long reaction period and increased the detection limit of direct binding of Salmonella antigen to 1x10(4) CFU/ml. The biosensor was able to detect Salmonella Typhimurium in chicken carcass wash fluid originally inoculated at a level of 20 CFU/ml after 12 h of nonselective enrichment. The planar optic biosensor shows promise as a fast, sensitive, reliable, and economical means of detecting food pathogens in the future.

Serra J.A. et al. *Risk assessment and critical control points from the production perspective.* Int J Food Microbiol. 1999; 46(1) : 9-26.p Abstract: The implementation of a risk analysis program as risk assessment and critical control points (RACCP) is most necessary in order to accomplish the foodborne industries current objective of total quality. The novelty of this technique, when compared to actual hazard analysis and critical control points (HACCP) and its extension to incorporate elements of quantitative risk analysis (QRA), is that RACCP considers the risk of the consequences produced by the production process performance deviations, both inside and outside the company, and also identifies their causative factors. On the other hand, the techniques to be taken in order to prevent or mitigate the consequences of such deviations must be consistent with the former data, but the need for a cost-benefit assessment must not be ignored so that the chosen technique be most profitable for the company. An example developed in a mineral water bottling plant showed that RACCP application is feasible and useful. During this example case, RACCP demonstrated it could obtain a profitable production process that keeps quality and safety of the final product at its maximum, while providing protection to both company and consumer.

Sethi D. et al. *A study of infectious intestinal disease in England: plan and methods of data collection.* Commun Dis Public Health. 1999; 2(2) : 101-7.p Abstract: The Committee on the Microbiological Safety of Food, set up in 1989 by the Department of Health in response to national epidemics of foodborne infection, considered the available evidence and commissioned a study of infectious intestinal disease (IID) in England. Seventy practices (with 489,500) patients overall) recruited from the Medical Research Council's General Practice Research Framework between August 1993 and January 1995 collected data for one year. The practice populations were representative of practices in England by area and urban/rural location, but with fewer small and affluent practices. There were five main components. i) A population cohort of 9776 (40% of those eligible) were enrolled to estimate the incidence and aetiology of IID in the community, and a large proportion were followed up. A median of 10% of patients on practice age-sex registers had moved away or died. ii) A nested case control component based on cases ascertained in the cohort was used to identify risk factors for IID in the community. iii) In a case control component used to identify risk factors and to estimate the incidence and aetiology of IID presenting in 34 general practices 70% of the 4026 cases returned risk factor questionnaires, 75% submitted stools, and matched controls were found for 75% of cases. iv) An enumeration component was used to estimate the incidence of IID presenting to general practitioners (GPs) in 36 practices and the proportion of specimens sent routinely for microbiological examination. v) In a socioeconomic costs component used to estimate the burden of illness of IID in the community and presenting to GPs 63% of those who returned a risk factor questionnaire also returned a socioeconomic questionnaire and were representative by age, sex, and social class. Despite variable enrolment and compliance the study sample had sufficient power for the multivariable analysis. The characteristics associated with low enrollment and compliance must be considered in the interpretation of the main study results.

Shapiro R. et al. *Salmonella Thompson associated with improper handling of roast beef at a restaurant in Sioux Falls, South Dakota.* J Food Prot. 1999; 62(2) : 118-22.p Abstract: In October 1996, we investigated an outbreak of Salmonella serotype Thompson infections associated with Restaurant A in Sioux Falls, South Dakota, and conducted two cohort studies among persons who ate at luncheons catered by Restaurant A. Fifty-two Salmonella Thompson infections were identified between 29 September and 14 October 1996. Infections occurred among employees and patrons at Restaurant A and among attendees at three luncheons catered by the restaurant on 7 October. Roast beef cooked at Restaurant A was the only food item significantly associated with illness. Cooking times and storage temperatures for roast beef were inadequate to prevent multiplication of Salmonella, and the chefs were unaware of proper cooking and storage temperatures. We conclude that improper handling of roast beef probably caused this outbreak of Salmonella Thompson infections. Better knowledge of food safety practices by the cooking staff at Restaurant A, through required food safety education, might have prevented the outbreak.

Shapiro R.L. et al. *The role of Gulf Coast oysters harvested in warmer months in Vibrio vulnificus infections in the United States, 1988-1996. Vibrio Working Group.* J Infect Dis. 1998; 178(3) : 752-9.p Abstract: Vibrio vulnificus infections are highly lethal and associated with consumption of raw shellfish and exposure of wounds to seawater. V. vulnificus infections were reported to the Centers for Disease Control and Prevention from 23 states. For primary septicemia infections, oyster trace-backs were performed and water temperature data obtained at harvesting sites. Between 1988 and 1996, 422 infections were reported; 45% were wound infections, 43% primary septicemia, 5% gastroenteritis, and 7% from undetermined exposure. Eighty-six percent of patients were male, and 96% with primary septicemia consumed raw oysters. Sixty-one percent with primary septicemia died; underlying liver disease was associated with fatal outcome. All trace-backs with complete information implicated oysters harvested in the Gulf of Mexico; 89% were harvested in water >22 degrees C, the mean annual temperature at the harvesting sites ($P < .0001$). Control measures should focus on the increased risk from oysters harvested from the Gulf of Mexico during warm months as well as education about host susceptibility factors.

Shapiro R.L. et al. *Transmission of epidemic Vibrio cholerae O1 in rural western Kenya associated with drinking water from Lake Victoria: an environmental reservoir for cholera?* Am J Trop Med Hyg. 1999; 60(2) : 271-6.p Abstract: Sub-Saharan Africa has the highest reported cholera incidence and mortality rates in the world. In 1997, a cholera epidemic occurred in western Kenya. Between June 1997 and March 1998, 14,275 cholera admissions to hospitals in Nyanza Province in western Kenya were reported. There were 547 deaths (case fatality rate = 4%). Of 31 Vibrio cholerae O1 isolates tested, all but one were sensitive to tetracycline. We performed a case-control study among 61 cholera patients and age-, sex-, and clinic-matched controls. Multivariate analysis showed that risk factors for cholera were drinking water from Lake Victoria or from a stream, sharing food with a person with watery diarrhea, and attending funeral feasts. Compared with other diarrheal pathogens, cholera was more common among persons living in a village bordering Lake Victoria. Cholera has become an important public health concern in western Kenya, and may become an endemic pathogen in the region.

Shemesh E. et al. *An outbreak of foodborne streptococcal throat infection.* Isr J Med Sci. 1994; 30(4) : 275-8.p Abstract: Streptococcal pharyngitis is a common disease of epidemic nature, usually transmitted by saliva droplets. We present an epidemiologic analysis of an outbreak of streptococcal pharyngitis in a military unit involving 75 soldiers. The causing organism was Streptococcus pyogenes (group A beta hemolytic Streptococcus, T28 M56), which was isolated from 53 affected individuals. The source of the epidemic was probably an army cook. The infection was transferred by a cabbage salad to individuals who became symptomatic within 24-48 h. This epidemic is a reminder of an exceptional route of streptococcal dissemination and one of the largest outbreaks of foodborne streptococcal pharyngitis documented.

Shewmake R.A. et al. *Food poisoning. Causes, remedies, and prevention.* Postgrad Med. 1998; 103(6) : 125-9, 134, 136.p Abstract: Food producers and consumers must continue to take precautions against foodborne diseases, and early diagnosis and appropriate treatment of these illnesses are essential. Food products and water can become contaminated with microorganisms and toxins that make people ill, and the very young, the elderly, and immunocompromised individuals are especially susceptible. Education of healthcare providers, food handlers, and the public is critical in reducing the incidence and spread of foodborne illness. Changes in eating habits and lifestyle and increased availability of both domestic and imported foods have made food hazards a more complex public health issue. Although most foodborne illnesses can be avoided by safe food handling procedures (see box on page 134), risk reduction is very important at every step from source to table. A concerted effort is needed to ensure continuing safety of the food supply in the United States while also assuring access to a wide variety of healthful foods. Time will tell whether consumers will accept irradiation of meats. If accepted, irradiation could rank in importance with pasteurization of milk and chlorination of water as a public health measure.

Shiferaw B. et al. *Prevalence of high-risk food consumption and food-handling practices among adults: a multistate survey, 1996 to 1997. The Foodnet Working Group.* J Food Prot. 2000; 63(11) : 1538-43.p Abstract: Risk factors for foodborne diseases include consumption of high-risk foods

and unsanitary food-handling practices; however, little is known about the prevalence of these risk factors in the general population. A survey was done in five FoodNet sites (California, Connecticut, Georgia, Minnesota, Oregon) to determine the prevalence of these risk factors in the population. A total of 7,493 adults were interviewed by telephone between 1 July 1996 and 30 June 1997. Results showed that 1.5% drank raw milk, 1.9% ate raw shellfish, 18% ate runny egg, 30% preferred pink hamburger, 93% said they almost always washed their cutting board after cutting raw chicken, and 93% said they almost always washed their hands after handling raw meat or poultry, during 5 days before interview. The results differed by state and demographic group. Consumption of raw shellfish (3.2%) and undercooked hamburger (43%) were more common in Connecticut than other states. Raw milk consumption was more common among people who lived on a farm (8.6%) compared with people who lived in a city or urban area (1.1%). Preference for undercooked hamburger was more common among men (35%), young adults (18 to 25 years, 33%), people with college education (38%), and among people with household income of more than $100,000/year (49%). African-Americans were less likely to prefer undercooked hamburger compared to other racial groups (10% versus 30%). Young adults compared to older adults were less likely to wash their hands after handling raw chicken (88% versus 95%), and men washed their hands less often than women (89% versus 97%). Although there were statistical differences between demographic groups, they are insufficient to warrant targeted educational programs.

Shinagawa K. *Analytical methods for Bacillus cereus and other Bacillus species.* Int J Food Microbiol. 1990; 10(2) : 125-41.p Abstract: Bacillus cereus can give rise to two distinct forms of foodborne disease, the emetic and the diarrhoeal syndromes. The emetic syndrome is believed to be associated with an emetic toxin pre-formed in food. Cooked rice is the most common vehicle, and the symptoms are similar to those of Staphylococcus aureus intoxication. The diarrhoeal type is caused by an enterotoxin and the symptoms generally parallel those of the Clostridium perfringens food poisoning. The heat resistance of B. cereus spores and the non-fastidious nature of the organism facilitates its survival and/or growth in a wide variety of foods. This review describes analytical methods available for the isolation, identification, and enumeration of the organism, in addition to details about biological and immunological methods for toxin assay. Data are also presented concerning the incidence and epidemiology of B. cereus food poisoning around the world, and especially in Japan.

Shohat T. et al. *International epidemiological and microbiological study of outbreak of Salmonella agona infection from a ready to eat savoury snack--II: Israel.* BMJ. 1996; 313(7065) : 1107-9.p Abstract: OBJECTIVES: To explain an increase in the incidence of salmonellosis caused by Salmonella agona in Israel between October 1994 and January 1995 in the light of an outbreak of S agona phage type 15 infection in England and Wales caused by consumption of a ready to eat savoury snack produced in Israel. DESIGN: Epidemiology of S agona in 1994-5 was analysed and two consecutive, case-control studies of 32 and 26 case-control pairs were performed. Phage typing and molecular methods were used to characterise strains of S agona isolated from cases and samples of the snack in Israel and England and Wales. RESULTS: The increase in the incidence of S agona between October 1994 and January 1995 was countrywide. Cases of infection with group B salmonella increased from 60% to 80% in children under 5 years old. In both case-control studies, cases consumed more of the snack than did controls (4.25 v 2.94 packets per week in the first study (P = 0.086) and 4.04 v 2.37 packets per week in the second study (P = 0.034)). When the two studies were combined there was a significant dose-response relation for the number of packets consumed weekly. Compared with consumption of less than two packets, the odds ratio was 1.43 for between two and six packets and 3.37 for seven or more packets (chi 2 for trend = 5.27, P = 0.02) S agona phage type 15 was isolated from a packet of the snack sold in Israel, and the strain was identical with those isolated from packets and cases in Israel and England and Wales. CONCLUSIONS: This outbreak of S agona was caused by the contamination of a snack produced in Israel. Even under modern operating conditions, large, widespread international outbreaks of foodborne disease can occur. The success of this investigation resulted from excellent international collaboration between public health authorities.

Shryock T.R. *Relationship between usage of antibiotics in food-producing animals and the appearance of antibiotic resistant bacteria.* Int J Antimicrob Agents. 1999; 12(4) : 275-8.p Abstract: Many studies and meeting reports have suggested that the use of some antibiotics in food animals can compromise the treatment of some infectious diseases in humans. Although the studies and reports are timely and important, it is difficult to assess the relative value of the conclusions in relationship to the overall situation concerning antibiotic resistant foodborne bacteria because the data used in the analyses are often of disparate origin. The studies have attempted to establish a cause and effect relationship between the use ('consumption') of antibiotics in food animals and treatment failures in human disease on the basis of [1] antibiotic usage data; [2] in vitro determinations of antibiotic susceptibility of animal and human isolates, [3] results obtained from controlled animal experiments or [4] epidemiological data. Each approach has sought to associate bacterial antibiotic resistance data with it's own immediate focus area of investigation. However, a true assessment of the degree of contribution to human antibiotic resistance problems from animal use can only be facilitated by comprehensively organizing these different approaches into a concerted, coordinated effort. Concurrently, the implementation of a multinational programme aimed at monitoring antibiotic usage in food animals and resistance in specific bacteria associated with those animals should be instituted. In parallel with this endeavour is the implementation of new prudent use

guidelines for antibiotic use by veterinarians. Through the use of science-based approaches like these, the development and spread of antibiotic resistant bacteria associated with food animals could be minimized and contained.

Sikes A. et al. *Feasibility of using food-grade additives to control the growth of Clostridium perfringens.* Int J Food Microbiol. 1999; 46(3) : 179-85.p Abstract: Previously, it was demonstrated that the combination of sucrose laurate (SL) ethylenediaminetetraacetate (E) and butylated hydroxyl anisole (B) (SLEB) was an effective antimicrobial agent against both gram-negative (aerobes) and gram-positive (facultative anaerobes) foodborne bacteria. This investigation examines the sensitivity of Clostridium perfringens to SLEB relative to: (1) the minimum inhibitory concentration (MIC) of SLEB required to inhibit the growth of C. perfringens and (2) the antibacterial effectiveness of different combination ratios of SLEB in fluid thioglycollate medium (FTM). Results indicated that the MIC of SLEB (1:1:1, v/v/v) against C. perfringens on tryptose sulfite cycloserine (TSC) agar was > 150 ppm at 37 degrees C. However, in FTM, a SLEB (1:1:1, v/v/v) concentration of > 100 ppm inhibited C. perfringens during an incubation (anaerobic) period of 196 h at 37 degrees C. The sensitivity of C. perfringens to different combination ratios was also investigated in FTM. The results showed that, when the concentrations of SL and E were held at 75 ppm in the SLEB combination, and the concentration of B increased from 0 to 75 ppm, C. perfringens growth increased initially during the first 24 h of incubation (37 degrees C) but remained constant during the next 48 h. Similarly, when concentrations of SL and E were held constant at 150 ppm in the SLEB combination and the B ratio increased from 50 to 150 ppm in FTM, C. perfringens viability decreased in all of the treated samples during 72-h incubation at 37 degrees C. The results indicated that SLEB was an effective inhibitor of C. perfringens growth activities, and the ratios of the components of SLEB can be adjusted to meet specific preservation needs.

Skirrow M.B. *Epidemiology of Campylobacter enteritis.* Int J Food Microbiol. 1991; 12(1) : 9-16.p Abstract: Campylobacter enteritis is the commonest form of infective diarrhoea in most developed countries of the world. In England and Wales laboratory reports indicate an annual incidence of about 85/100,000, but the true rate is probably nearer 1100/100,000. Measured costs run to many millions of pounds per year. Most infections are sporadic and believed to be foodborne; large outbreaks are infrequent and mostly due to the consumption of raw milk or unchlorinated water. Raw meats and animal products, notably broiler chickens, are the main source of campylobacters in food. A case-control study in the U.S.A., where eating habits are similar to those in Europe, attributed about one-half of human Campylobacter infections to the consumption of chickens. The production of Campylobacter-free chickens is not yet practicable, but considerable progress could be made to this end with sufficient motivation and resources from government and the poultry industry.

Skovgaard N. *The need for continuous training in food factories.* Int J Food Microbiol. 1990; 11(2) : 119-25.p Abstract: The dissemination in food factories of the organisms I have referred to earlier, represent significant and interesting issues of public health concern. Yet there seem to be difficulties in incorporating material in education-training-information programmes explaining merely the most simple and basic facts about the risk involved in food being contaminated in food factories. Such educational programmes are essential components in the overall scheme of foodborne disease control, yet they often represent the weakest links in the control chain. There has been a decline in the emphasis on food hygiene in some programmes at the level of institutions of higher education, and a de-emphasis on food hygiene has occurred over the past few decades in schools of veterinary medicine in some parts of the world. This committee has taken active steps to improve this situation by convening a professorial consultation on post-graduate teaching in advanced food microbiology, Copenhagen 1989 (Park, 1990). The public, as well as politicians, focus for the time being on chemical contamination of foods, possible presence of residues, thereby ignoring the fact that statistically it is not the residues that cause deaths which count, but, without a shadow of doubt, the foodborne pathogens. This fact emphasizes the need for intensive training in preventive hygienic measures. Since representatives of the food industry are participating in the Symposium, I would like to balance the problems by saying: we all share a responsibility in securing education in food hygiene in food factories.(ABSTRACT TRUNCATED AT 250 WORDS).

Slaten D.D. et al. *An outbreak of Bacillus cereus food poisoning--are caterers supervised sufficiently.* Public Health Rep. 1992; 107(4) : 477-80.p Abstract: Bacillus cereus is an uncommonly reported cause of foodborne illness in the United States. In May 1989, an outbreak of B. cereus gastroenteritis occurred among 140 guests who had attended a catered wedding reception in Napa, CA. Investigation established Cornish game hens served at the event as the vehicle for disease transmission (OR = 29, P = 0.0001). Although the spores of B. cereus are ubiquitous, large numbers of toxin-producing organisms (more than 10(5) per gram of food) are required for illness to occur. In the Napa outbreak, bacterial multiplication was facilitated at several points during the preparation and transportation of the food. While a licensed restaurant kitchen was used, the facilities were clearly inadequate for the event. At present, the California Health and Safety Code does not address the scope of catering operations. As caterers increase in number, there will be a growing need for governmental oversight to ensure that food production on a large scale is conducted safely.

Slifko T.R. et al. *Effect of high hydrostatic pressure on cryptosporidium parvum infectivity.* J Food Prot. 2000;

63(9) : 1262-7.p Abstract: The incidence of foodborne disease outbreaks caused by contaminated low-pH fruit juices is increasing. With recent mandatory pasteurization of apple juice and the industry's concerns of food safety, fruit juice processors are showing more interest in alternative nonthermal technologies that can kill >99.99% of microbial pathogens present in foods. The association of the coccidian protozoan, Cryptosporidium, with diarrheal disease outbreaks from contaminated tap water and fruit juice raises a safety concern in the food and beverage industries. The objective of this study was to evaluate the effects of high hydrostatic pressure (HHP) on C. parvum oocysts. Oocysts were suspended in apple and orange juice and HHP treated at 5.5 x 10(8) Pa (80,000 psi) for 0, 30, 45, 60, 90, and 120 s. Oocyst viability was assessed by excystation using bile salts and trypsin while the cell culture foci detection method was used to assess infectivity. Results indicated that HHP inactivated C. parvum oocysts by at least 3.4 log10 after 30 s of treatment. No infectivity was detected in samples exposed to > or =60 s of HHP and >99.995% inactivation was observed. This study demonstrated that HHP efficiently rendered the oocysts nonviable and noninfectious after treatment at 5.5 x 10(8) Pa.

Slutsker L. et al. *Foodborne diseases. Emerging pathogens and trends.* Infect Dis Clin North Am. 1998; 12(1) : 199-216.p Abstract: The epidemiology of foodborne diseases is rapidly changing. In the past 15 years, new foodborne pathogens, such as Campylobacter jejuni and Escherichia coli O157:H7, have emerged as important public health problems. Well-recognized pathogens, such as Salmonella serotype Enteritidis, have increased in prevalence or become associated with new vehicles, and pathogens such as C. jejuni and S. Typhimurium are becoming increasingly resistant to antimicrobial agents. Evolving trends in foodborne diseases are being driven by the same factors that have led to the emergence of other infectious diseases: changes in demographic characteristics of the population, human behavior, industry, and technology and the shift toward a global economy, microbial adaptation, and breakdown in the public health infrastructure. Addressing emerging foodborne disease will require more sensitive and timely surveillance, enhanced methods of laboratory identification and subtyping, and identification of effective prevention and control strategies.

Slutsker L. et al. *A nationwide case-control study of Escherichia coli O157:H7 infection in the United States.* J Infect Dis. 1998; 177(4) : 962-6.p Abstract: Risk factors for Escherichia coli 0157:H7 infection were investigated in a case-control study at 10 medical centers throughout the United States. Among 73 case-patients and 142 matched controls, exposures in the 7 days before illness associated with E. coli 0157:H7 infection in univariate analysis included consumption of hamburger (matched odds ratio [MOR], 3.8; 95% confidence interval [CI], 1.9-7.9), undercooked hamburger (MOR, 4.5; 95% CI, 1.6-12.2), or hot dogs (MOR, 2.2; 95% CI, 1.1-4.4); eating at a fast-food restaurant (MOR, 2.3; 95% CI, 1.1-4.6); drinking unchlorinated well water (MOR, 2.4; 95% CI, 1.1-5.7); swimming in a pond (MOR, 5.4; 95% CI, 1.1-26.0); and having a household member with diarrhea (MOR, 11.9; 95% CI, 2.7-53.5). In multivariate analysis, only eating undercooked hamburger remained associated with infection. Seven (8%) of 93 patients developed hemolytic uremic syndrome and 1 died. Prevention strategies aimed at modifying risk factors may help to reduce the risk of infection with E. coli 0157:H7.

Smith H.V. *Detection of parasites in the environment.* Parasitology . 1998; 117 Suppl : S113-41.p Abstract: The environmental route of transmission is important for many protozoan and helminth parasites, with water, soil and food being particularly significant. Both the potential for producing large numbers of transmissive stages and their environmental robustness (with the ability to survive in moist microclimates for prolonged periods of time) pose persistent threats to public and veterinary health. Increased demands made on natural resources increase the likelihood of encountering environments and produce contaminated with parasites. In the last 30 years, endemic and epidemic waterborne and foodborne outbreaks in developed countries have led to a reappraisal of conventional isolation and detection methods. While these methods have proved invaluable in our understanding of environmental transmission routes for helminths, they have been less effective for the parasitic protozoa. Robust, efficient detection, viability and typing methods are required to assess risk and to further epidemiological understanding. Greater awareness of parasite contamination of our environment and its impact on health has precipitated the development of better detection methods. Currently, nowhere is this more apparent than with Cryptosporidium, with a broad range of immunological, microscopical and molecular methods available. The upsurge in molecular techniques, particularly the polymerase chain reaction, for determining occurrence and viability have brought with them the added benefits of increased sensitivity and specificity, yet many methods still have to be shown to address these issues consistently in the field. Rapid commercialization of reagents and standardization of methods provide consistency. The advances identified in non-destructive and destructive methods for the protozoa have application for helminths and emerging pathogens and should determine the importance of the matrices involved in the environmental transmission of parasites, further safeguarding public and veterinary health.

Smith J.L. *Foodborne illness in the elderly.* J Food Prot. 1998; 61(9) : 1229-39.p Abstract: The elderly (> or = 65 years of age) are more susceptible to morbidity and mortality from foodborne-induced gastroenteritis than younger individuals. Several factors contribute to the increased susceptibility to foodborne infections as well as other infections in elderly populations. These include an age-associated decrease in humoral and cellular immunity, age-related changes in the gastrointestinal tract (decreased production of gastric acid and decreased intestinal motility), malnutrition, lack of exercise, entry into nursing

homes, and excessive use of antibiotics. Data from foodborne outbreaks associated with nursing homes indicate that the elderly are more likely to die from foodborne Campylobacter, Clostridium perfringens, Escherichia coli O157:H7, Salmonella, and Staphylococcus aureus infections than the general population. Infections by Salmonella species are the most common cause of illness and death in nursing homes with Salmonella enteritidis as the major cause of both morbidity and mortality. While it is impossible to turn back the clock, practicing a healthy life-style with regular exercise, maintaining a balanced diet, receiving regular health care, paying attention to personal hygiene, and monitoring food preparation and handling should lead to a reduced incidence of foodborne and other infections in the elderly.

Smith J.L. *Foodborne infections during pregnancy.* J Food Prot. 1999; 62(7) : 818-29.p Abstract: The consequences of foodborne illness can be particularly devastating during pregnancy because both the woman and her fetus are at risk. Escalated production of progesterone during pregnancy leads to down-regulation of cellular (cell-mediated) immune functions. Many foodborne pathogens (and other pathogens) are intracellular pathogens, and infections caused by these pathogens are controlled by cell-mediated immunity. The pregnancy-induced decrease in cell-mediated immune functions leads to increased susceptibility of the pregnant woman to certain infections. Hepatitis E virus, Coxiella burnetii, Listeria monocytogenes, and Toxoplasma gondii are intracellular pathogens that have a predilection for the maternal-fetal unit and may induce serious disease in the mother and/or fetus. In the United States, T. gondii and L. monocytogenes are the most important foodborne pathogens in pregnancy, and these organisms can induce death or grave disease in the fetus and newborn. The pregnant woman, in order to protect herself and her fetus from the consequences of foodborne illness, must practice a high standard of food hygiene and personal cleanliness.

Smith R.A. et al. *The risks and prevention of contamination of beef feedlot cattle: the perspective of the United States of America.* Rev Sci Tech. 1997; 16(2) : 359-68.p Abstract: There are currently no scientifically defined critical management points or critical control points to manage foodborne pathogens at the pre-harvest level. Research is ongoing: much of the pre-harvest research is funded by producer organisations. The beef industry has Beef Quality Assurance (BQA) programmes in place and these are dynamic. Groups of cattlemen have made a very strong commitment to reducing foodborne pathogens in beef. Fewer Escherichia coli O157:H7 organisms are shed by feedlot cattle near the end of the feeding period than by newly arrived cattle. Moreover, there is less shedding of the organisms in cattle of slaughter age than in younger cattle. The prevalence of E. coli O157:H7 in feedlot cattle is similar to that in range cattle. This suggests that concentrating cattle in feedlot dirt pens does not increase the risk of shedding E. coli organisms. Pen maintenance, considered a good management practice, appears to be an adequate means of keeping pathogen levels in pens low. It is not likely that pre-harvest food safety programmes will eliminate the threat of pathogens such as E. coli O157:H7 or Salmonella. The management of foodborne pathogens will become part of an integrated programme to enhance food safety which includes the producer, the packer, the distributors, retailers and the consumer. The feedlot industry initiated a residue avoidance programme several years ago. As a result, the risk of chemical residues in beef from feedlots in the United States of America is near zero. Hazard analysis and critical control point-type prevention programmes, using scientifically based critical management points, will help ensure that the risk remains negligible.

Smittle R.B. *Microbiological safety of mayonnaise, salad dressings, and sauces produced in the United States: a review.* J Food Prot. 2000; 63(8) : 1144-53.p Abstract: The literature on the death and survival of foodborne pathogens in commercial mayonnaise, dressing, and sauces was reviewed and statistically analyzed with emphasis on Salmonella, Escherichia coli O157:H7, and Listeria monocytogenes. The absence of reports of foodborne illness associated directly with the consumption of commercially prepared acidic dressings and sauces is evidence of their safety. Salmonella, E. coli O157:H7, E. coli, L. monocytogenes, Staphylococcus aureus, and Yersinia enterocolitica die when inoculated into mayonnaise and dressings. Historically, mayonnaise and dressings have been exempt from the acidified food regulations and have justly deserved this status due primarily to the toxic effect of acetic and to a lesser extent lactic and citric acids. These organic acids are inimical to pathogenic bacteria and are effective natural preservatives with acetic being the most effective in killing pathogenic bacteria at the pH values encountered in these products. Statistical analysis on data reported in the literature shows that the most important and significant factor in destroying pathogenic bacteria is pH as adjusted with acetic acid followed by the concentration of acetic acid in the water phase. The reported highest manufacturing target pH for dressings and sauces is 4.4, which is below the 4.75 pKa of acetic acid and below the reported inhibitory pH of 4.5 for foodborne pathogens in the presence of acetic acid. The overall conclusion is that these products are very safe. They should remain exempt from the acidified food regulations providing adequate research has been done to validate their safety, and the predominant acid is acetic and reasonable manufacturing precautions are taken.

Sobel J. et al. *Reduction of fecal contamination of street-vended beverages in Guatemala by a simple system for water purification and storage, handwashing, and beverage storage.* Am J Trop Med Hyg. 1998; 59(3) : 380-7.p Abstract: Street-vended foods and beverages, an integral part of urban economies in the developing world, have been implicated in cholera transmission in Latin America. To improve the microbiologic quality of market-vended beverages in Guatemala, we tested a simple system consisting of dilute bleach (4.95% free available chlorine) for water purification, narrow-mouth plastic vessels with

spigots for disinfecting and storing water and for preparing and storing beverages, handwashing soap, and education in using the system. We conducted a randomized controlled intervention trial among 41 vendors who received the intervention and 42 control vendors, comparing total and fecal coliform bacteria and Escherichia coli contamination of market-vended beverages, stored water, and vendors' hands. Samples were obtained at baseline and at each of six weekly follow-up visits. At baseline, fecal coliform bacteria were found in 40 (48%) market-vended beverages and E. coli in 14 (17%). When compared with samples from control vendors, a significant decrease in total coliform ($P < 0.001$) and fecal coliform ($P < 0.001$) bacteria in samples of stored water and beverages sold by intervention vendors was observed over the course of the study. The vessel system was well accepted by vendors. This simple inexpensive system consisting of hypochlorite disinfectant, plastic vessels, soap, and education can significantly reduce fecal contamination of market-vended beverages.

Sobrino O.J. et al. *Antibacterial activity of Lactobacillus sake isolated from dry fermented sausages.* Int J Food Microbiol. 1991; 13(1) : 1-10.p Abstract: Lactic acid bacteria isolated from Spanish dry fermented sausages were screened for antagonistic activities under conditions that eliminated the effects of low pH and hydrogen peroxide. From 720 isolates tested 119 were inhibitory to Lactobacillus fermentum CECT285. The isolates showing the largest inhibitory activity exhibited an antagonistic effect against several other lactobacilli and the selected foodborne pathogens Staphylococcus aureus and Listeria monocytogenes. Comparison of the antimicrobial spectra of the supernatants suggested that the inhibitory compounds were not identical. The isolates were tentatively characterized as Lactobacillus sake. One of the isolates, L. sake 148 was chosen for further study. The compound excreted by L. sake 148 was active against various lactobacilli and several Gram-positive foodborne bacteria, but not against the Gram-negative bacteria tested. The antagonistic effects were almost eliminated by treatment with proteases, whereas they were heat resistant and bacteriostatic rather than bacteriocidal.

Sockett P.N. et al. *Foodborne disease surveillance in England and Wales: 1989-1991.* Commun Dis Rep CDR Rev. 1993; 3(12) : R159-73.p Abstract: This review summarises reports of food poisoning, salmonellosis, campylobacteriosis and other acute foodborne illness to the PHLS Communicable Disease Surveillance Centre, and notifications of food poisoning collated by the Office of Population Censuses and Surveys, in the period 1989-1991. During this period there were continuing rises in notifications of food poisoning and reports of salmonellosis and campylobacteriosis. There was considerable success in the control of foodborne listeriosis. Newly emerging pathogens, such as Vero cytotoxin producing Escherichia coli, became more important. There was unprecedented scrutiny of the salmonella data by experts and politicians, reflecting continuing concern over the role of eggs as well as poultry meat in the increase of Salmonella enteritidis phage type 4 infection. This concern, along with advances in information technology, has led to developments in the collection and dissemination of information which continue to be implemented.

Sofos J.N. et al. *Nonacid meat decontamination technologies: model studies and commercial applications.* Int J Food Microbiol. 1998; 44(3) : 171-88.p Abstract: Increased consumer awareness and concern about microbial foodborne diseases has resulted in intensified efforts to reduce contamination of raw meat, as evidenced by new meat and poultry inspection regulations being implemented in the United States. In addition to requiring operation of meat and poultry slaughtering and processing plants under the principles of the hazard analysis critical control point (HACCP) system, the new regulations have established microbiological testing criteria for Escherichia coli and Salmonella, as a means of evaluating plant performance. These developments have renewed and intensified interest in the development and commercial application of meat and poultry decontamination procedures. Technologies developed and evaluated for decontamination include live animal cleaning/washing, chemical dehairing, carcass knife-trimming to remove physical contaminants, steam/hot water-vacuuming for spot-cleaning/decontamination of carcasses, spray washing/rinsing of carcasses with water of low or high pressures and temperatures or chemical solutions, and exposure of carcass sides to pressurized steam. Under appropriate conditions, the technologies applied to carcasses may reduce mean microbiological counts by approximately one-three log colony forming units (cfu)/cm2, and some of them have been approved and are employed in commercial applications (i.e., steam-vacuuming; carcass spray-washing with water, chlorine, organic acid or trisodium phosphate solutions; hot water deluging/spraying/rinsing, and pressurized steam). The contribution of these decontamination technologies to the enhancement of food safety will be determined over the long term, as surveillance data on microbial foodborne illness are collected. This review examines carcass decontamination technologies, other than organic acids, with emphasis placed on recent advances and commercial applications.

Spearing N.M. et al. *Direct costs associated with a nosocomial outbreak of Salmonella infection: an ounce of prevention is worth a pound of cure.* Am J Infect Control. 2000; 28(1) : 54-7.p Abstract: BACKGROUND: Nosocomial outbreaks of Salmonella infections in Australia are an infrequent but significant source of morbidity and mortality. Such an outbreak results in direct, measurable expenses for acute care management, as well as numerous indirect (and less quantifiable) costs to those affected, the hospital, and the wider community. This article describes the significant direct costs incurred as a result of a nosocomial outbreak of Salmonella infection involving patients and staff. METHOD: Information on costs incurred by the hospital was gathered from a number of sources. The data were grouped into 4 sections (medical costs,

investigative costs, lost productivity costs, and miscellaneous) with use of an existing tool for calculating the economic impact of foodborne illness. RESULTS: The outbreak cost the hospital more than AU $120, 000. (US $95,000). This amount is independent of more substantial indirect costs. CONCLUSION: Salmonella infections are preventable. Measures to aid the prevention of costly outbreaks of nosocomial salmonellosis, although available, require an investment of both time and money. We suggest that dedication of limited resources toward such preventive strategies as education is a practical and cost-effective option for health care facilities.

St. Louis M.E. et al. *Epidemic cholera in West Africa: the role of food handling and high-risk foods.* Am J Epidemiol. 1990; 131(4) : 719-28.p Abstract: During an epidemic of cholera in Guinea, West Africa, in 1986, the authors conducted two studies of risk factors for transmission. In the capital city, 35 hospitalized cholera patients were more likely than 70 neighborhood-matched controls to have eaten leftover peanut sauces (odds ration (OR) = 3.1, 95% confidence interval (CI) 1.2-8.2), but less likely to have eaten tomato sauces (OR = 0.2, 95 percent CI 0.1-0.9). Hand washing with soap before meals by all family members protected against cholera (OR = 0.2, 95 percent CI 0.02-0.96), suggesting that persons asymptomatically infected with Vibrio cholerae 01 may have been the initial source for contamination of the leftover foods. Laboratory studies demonstrated that V. cholerae multiplied rapidly in peanut sauce (pH 6.0), but not in the more acidic tomato sauce (pH 5.0). In an outbreak of cholera-like illness after a rural funeral, illness was strongly associated with eating a rice meal served over many hours without reheating. These studies demonstrated that, in this epidemic, many cases of severe cholera were associated with eating specific cooked foods that could support bacterial growth after contamination of these foods with V. cholerae within the household. Epidemic control efforts should include identification of high-risk foods and promotion of simple changes in food handling behaviors to lower the risk of foodborne transmission.

Sterling C.R. et al. *Cyclospora: an enigma worth unraveling.* Emerg Infect Dis. 1999; 5(1) : 48-53.p Abstract: In part, Cyclospora cayetanensis owes its recognition as an emerging pathogen to the increased use of staining methods for detecting enteric parasites such as Cryptosporidium. First reported in patients in New Guinea in 1977 but thought to be a coccidian parasite of the genus Isospora, C. cayetanensis received little attention until it was again described in 1985 in New York and Peru. In the early 1990s, human infection associated with waterborne transmission of C. cayetanensis was suspected; foodborne transmission was likewise suggested in early studies. The parasite was associated with several disease outbreaks in the United States during 1996 and 1997. This article reviews current knowledge about C. cayetanensis (including its association with waterborne and foodborne transmission), unresolved issues, and research needs.

Stewart D. et al. *Specificity of the BAX polymerase chain reaction system for detection of the foodborne pathogen Listeria monocytogenes.* J AOAC Int. 1998; 81(4) : 817-22.p Abstract: The polymerase chain reaction (PCR) can be used for rapid and specific detection of foodborne pathogens. One commercial kit, the Qualicon BAX system uses PCR to detect Listeria monocytogenes in enrichment cultures derived from food and environmental samples. The specificity and sensitivity of the BAX system for detecting L. monocytogenes were characterized by using both pure and mixed cell cultures, and optimal conditions for production of cell lysates were determined. The BAX system was highly specific for L. monocytogenes, and no interference was seen in the presence of either other Listeria species or microbes from other genera. The assay detected L. monocytogenes at 10(5)-10(6) colony-forming units/mL. This sensitivity is adequate for detecting viable cells after enrichment but prevents false-positive signals from nonviable cells.

Stolle A. et al. *Viral infections transmitted by food of animal origin: the present situation in the European Union.* Arch Virol Suppl. 1997; 13 : 219-28.p Abstract: The goal of this presentation was to clarify which foods are involved in viral diseases, which viruses are transmitted via food and how to evaluate the risk of a foodborne viral infection. Food items frequently identified as cause of viral disease outbreaks were shellfish harvested in sewage-contaminated water. Another common source of foodborne viral illness was cold food contaminated by infected food handlers. In the European Union the viruses most frequently associated with foodborne illness were hepatitis A virus and the SRSV's. A few isolated cases of foodborne hepatitis E were reported in Mediterranean countries. Compared to other foodborne diseases, those caused by viruses are less severe and seldom fatal. This might be a reason why the problem of viral contamination of food has been neglected. Yet, because many foodborne viral diseases are not recognized either as foodborne or as caused by viruses, the actual number of cases must be assumed to be significantly higher than the reported number. Consequently, food associated diseases of viral origin should be granted more attention.

Strauch D. et al. *Hygienic aspects of the production and agricultural use of animal wastes.* Zentralbl Veterinarmed [B]. 1994; 41(3) : 176-228.p Abstract: Regarding the hygienic aspects of the production and use of animal wastes, further research on the following aspects is essential: pathogenic agents present in residues of animal production in the context of transmissible multifactorial diseases and the epidemiology of pathogens under different ecological conditions; recycling of toxic agents, e.g., copper, selenium and iodine, in animal wastes in the context of the food chain from soil to humans; hygienic effects of animal wastes on water as regards the standards required by medical authorities; effects of agents used to increase animal production, or used for medicinal purposes, which are present as residues in animal excreta and may be hazardous to public health; effects of animal excreta on microbiological processes in the soil; effects of dust and

airborne microbial emissions from animal production, and finally, processes of self-disinfection of manure and livestock slurry during storage as a means of reducing the amounts of chemical disinfectants used, of reducing environmental pollution, and of studying the application of biotechnological methods to disinfect manure and livestock slurry, this study being of particular importance.

Stringer S.C. et al. *Thermal inactivation of Escherichia coli O157:H7.* Symp Ser Soc Appl Microbiol. 2000; (29) : 79S-89S.p Abstract: Verotoxin-producing Escherichia coli O157:H7 is a cause of serious foodborne illness. It has a very small infectious dose and so it is vital to eliminate this pathogen from food. As heat treatment is the method of bacterial destruction most frequently used in food processing, accurate prediction of thermal death rates is necessary to achieve desired safety margins whilst minimizing processing. In most studies thermal inactivation has been described using first-order reaction kinetics and D-values. Whilst this approach does not seem justified on a theoretical basis, and may increase inaccuracy, there is no doubt that it is convenient and in many cases provides an adequate description of thermal death. A review of published data on the measured thermal inactivation of E. coli O157:H7 shows no strong evidence that a heat treatment of 70 degrees C for 2 min (or equivalent) fails to deliver a 6-decimal reduction in cell numbers.

Suzuki Y. et al. *Restriction fragment length polymorphisms analysis by pulsed-field gel electrophoresis for discrimination of Staphylococcus aureus isolates from foodborne outbreaks.* Int J Food Microbiol. 1999; 46(3) : 271-4.p Abstract: A number of outbreaks of disease due to Staphylococcus aureus occurring in Aichi-ken, Japan, have provided the opportunity to investigate aspects of the molecular epidemiology of this and related organisms. Coagulase types, enterotoxin types, phage types, and restriction fragment length polymorphisms (RFLPs) as assessed by pulsed-field gel electrophoresis (PFGE) was performed for S. aureus infections diagnosed in the area of Aichi-ken. Among the 56 isolates of S. aureus from 30 outbreaks, 15 distinctive RFLP types were found by digestion with the restriction enzyme, SmaI. A total of 32 isolates from patients, foodstuffs and cooks on six occasions had the same RFLP types, coagulase types, enterotoxin types and phage types in the same outbreaks. Moreover, the coagulase and phage types could be separated in terms of RFLP. In one outbreak, ten isolates, which were derived from six patients, two foodstuffs and two cooks, had the same coagulase type, enterotoxin type, phage type, and RFLP type. This PFGE method may therefore prove useful for subclassifying S. aureus and differentiating isolates of the same coagulase types and phage types derived from sporadic cases and those derived from foodborne outbreaks.

Svensson L. *Diagnosis of foodborne viral infections in patients.* Int J Food Microbiol. 2000; 59(1-2) : 117-26.p Abstract: A significant global problem is the microbiological contamination of foods and water. The microorganisms associated with about half of the foodborne disease outbreaks still go unrecognized, primarily as a result of inadequate diagnostic methods and sampling. A significant amount of food- and waterborne diseases are associated with viruses, information that has been obtained only in recent years. Improved diagnostic methods have established that caliciviruses are the most important non-bacterial pathogens associated with food- and waterborne outbreaks, and are the major cause of seafood-associated gastroenteritis.

Swaddiwudhipong W. et al. *A common source foodborne outbreak of E1 Tor cholera following the consumption of uncooked beef.* J Med Assoc Thai. 1992; 75(7) : 413-7.p Abstract: In July 1988, an outbreak of cholera with 71 culture-confirmed cases of biotype El Tor, serotype Ogawa, occurred in a non-endemic area in Mae Sot district, Tak province. Fifty-two cases had diarrhea and 19 had asymptomatic cholera infection. No cases died. Epidemiological investigation revealed a significant association between cholera infection and the consumption of uncooked beef. Increased risk of cholera infection was observed when the incriminated beef was kept at room temperature and consumed later without cooking. The beef was possibly contaminated with V. cholerae O1 from an infected butcher who may have contracted the disease from his foreign worker who was found to have asymptomatic cholera infection. Early detection of the outbreak and rapid identification of transmission source permitted prompt appropriate control measures which, therefore, prevented the outbreak from spreading to other communities. As outbreaks of foodborne diseases, including cholera, have been reported frequently after the consumption of raw food in many parts of Thailand, preventive educational efforts should be directed towards modifying the traditional behavior patterns of consuming raw food among these Thai people.

Swaminathan B. et al. *Rapid detection of food-borne pathogenic bacteria.* Annu Rev Microbiol. 1994; 48 : 401-26.p Abstract: Recent advancements in biotechnology are rapidly altering the diagnostic procedures used in microbiologic analysis of foods. Biochemical identification tests have been miniaturized and automated, making them faster and more economical. Pathogenic bacteria that were previously isolated and identified after labor- and time-intensive enrichment and plating procedures can now be detected by measuring specific physicochemical changes resulting from their growth or metabolic activity. Nucleic acid and antibody-based assays are now used to rapidly and reliably detect pathogenic bacteria in foods. Nevertheless, foods offer unique challenges to the application of these techniques because of their complexity and variety, their interference with the rapid detection methods, and the need to detect pathogenic bacteria when they are present in foods at very low levels. Methods to sequester target pathogenic bacteria from interfering food components and to concentrate them in small volumes are needed to enable the

efficient application of rapid detection and identification methods.

Swerdlow D.L. et al. *Epidemic cholera among refugees in Malawi, Africa: treatment and transmission.* Epidemiol Infect. 1997; 118(3) : 207-14.p Abstract: Between 23 August and 15 December 1990 an epidemic of cholera affected Mozambican refugees in Malawi causing 1931 cases (attack rate = 2.4%); 86% of patients had arrived in Malawi < 3 months before illness onset. There were 68 deaths (case-fatality rate = 3.5%); most deaths (63%) occurred within 24 h of hospital admission which may have indicated delayed presentation to health facilities and inadequate early rehydration. Mortality was higher in children < 4 years old and febrile deaths may have been associated with prolonged i.v. use. Significant risk factors for illness ($P < 0.05$) in two case-control studies included drinking river water (odds ratio [OR] = 3.0); placing hands into stored household drinking water (OR = 6.0); and among those without adequate firewood to reheat food, eating leftover cooked peas (OR = 8.0). Toxigenic V. cholerae O1, serotype Inaba, was isolated from patients and stored household water. The rapidity with which newly arrived refugees became infected precluded effective use of a cholera vaccine to prevent cases unless vaccination had occurred immediately upon camp arrival. Improved access to treatment and care of paediatric patients, and increased use of oral rehydration therapy, could decrease mortality. Preventing future cholera outbreaks in Africa will depend on interrupting both waterborne and foodborne transmission of this pathogen.

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Taege A.J. *Listeriosis: recognizing it, treating it, preventing it.* Cleve Clin J Med. 1999; 66(6) : 375-80.p Abstract: Listeria monocytogenes has become a major pathogen in foodborne illness. It most often affects patients who are pregnant, at the extremes of life, or immunocompromised in some way. A variety of clinical manifestations are possible, but bacteremia and meningitis are most common. This article reviews the epidemiology, microbiology, populations at risk, clinical manifestations, treatment, and prevention of listeriosis.

Takeshi K. et al. *Direct detection by PCR of Escherichia coli O157 and enteropathogens in patients with bloody diarrhea.* Microbiol Immunol. 1997; 41(10) : 819-22.p Abstract: Direct detection of Escherichia coli O157 and foodborne pathogens associated with bloody diarrhea were achieved using polymerase chain reaction (PCR) after the preparation of DNA from stool specimens using the microspin technique. PCR was compared with cultivation and toxin production tests with respect to the efficiency of detection of each pathogen; E. coli O157, Vibrio parahaemolyticus, Salmonella serovar Enteritidis and Campylobacter jejuni. Detection of some or all of the above pathogens in clinical stool specimens was achieved using PCR. The minimum number of cells required for the detection of the above pathogens by PCR was 10(1) CFUs/0.5 g of stool sample. PCR was completed within 6 hr. The above pathogens were also detected in cultivation and toxin production tests. Partial purification of the template DNA using the microspin technique was essential for the elimination of PCR inhibitors from the DNA samples. This PCR method is an accurate, easy-to-read screening method for the detection of Shiga-like toxin producing E. coli O157 and enteropathogens associated with bloody diarrhea in stool specimens.

Taormina P.J. et al. *Infections associated with eating seed sprouts: an international concern.* Emerg Infect Dis. 1999; 5(5) : 626-34.p Abstract: Recent outbreaks of Salmonella and Escherichia coli O157:H7 infections associated with raw seed sprouts have occurred in several countries. Subjective evaluations indicate that pathogens can exceed 107 per gram of sprouts produced from inoculated seeds during sprout production without adversely affecting appearance. Treating seeds and sprouts with chlorinated water or other disinfectants fails to eliminate the pathogens. A comprehensive approach based on good manufacturing practices and principles of hazard analysis and critical control points can reduce the risk of sprout-associated disease. Until effective measures to prevent sprout-associated illness are identified, persons who wish to reduce their risk of foodborne illness from raw sprouts are advised not to eat them; in particular, persons at high risk for severe complications of infections with Salmonella or E. coli O157:H7, such as the elderly, children, and those with compromised immune systems, should not eat raw sprouts.

Tapia de Daza M.S. et al. *[Ecological and food safety considerations about products of vegetable origin]*. Arch Latinoam Nutr. 1994; 44(4) : 232-41.p Abstract: Media have paid much attention in recent years to emerging microbiological problems in foods of plant origin. The potential for contamination of fruits and vegetables is high because of the wide variety of conditions to which produce is exposed during growth, harvest, processing and distribution. These considerations acquire great significance in the current scenario of the new processing techniques that offer attributes of convenience and fresh-likeness in response to changes in consumption patterns and increased demand of fresh and minimally processed fruits and vegetables. Thus, reliance on low temperature storage and on improved packaging materials/techniques have increased. Even if produce had not been considered a major vector for foodborne diseases, technologies that extend shelf-life by decreasing the rate of product deterioration might increase the risks associated with pathogenic microorganisms, especially of psychotropic nature, by allowing sufficient time for their growth when retarding the development of competitive spoilage organisms. Processing steps that modify the food microenvironment open new possibilities to support pathogens that, for ecological reason, would have never been naturally present in produce. Ecological and safety

aspects related to fruits and vegetables as well as foodborne disease outbreaks traceable to produce and reportedly due to Salmonella and Shigella spp., Listeria monocytogenes, Clostridium botulinum, Aeromonas hydrophila, Campylobacter jejuni are reviewed.

Tauxe R.V. *Emerging foodborne diseases: an evolving public health challenge.* Emerg Infect Dis. 1997; 3(4) : 425-34.p Abstract: The epidemiology of foodborne disease is changing. New pathogens have emerged, and some have spread worldwide. Many, including Salmonella, Escherichia coli O157:H7, Campylobacter, and Yersinia enterocolitica, have reservoirs in healthy food animals, from which they spread to an increasing variety of foods. These pathogens cause millions of cases of sporadic illness and chronic complications, as well as large and challenging outbreaks over many states and nations. Improved surveillance that combines rapid subtyping methods, cluster identification, and collaborative epidemiologic investigation can identify and halt large, dispersed outbreaks. Outbreak investigations and case-control studies of sporadic cases can identify sources of infection and guide the development of specific prevention strategies. Better understanding of how pathogens persist in animal reservoirs is also critical to successful long-term prevention. In the past, the central challenge of foodborne disease lay in preventing the contamination of human food with sewage or animal manure. In the future, prevention of foodborne disease will increasingly depend on controlling contamination of feed and water consumed by the animals themselves.

Thomas L.V. et al. *Effect of three preservatives on the growth of Bacillus cereus, Vero cytotoxigenic Escherichia coli and Staphylococcus aureus, on plates with gradients of pH and sodium chloride concentration.* Int J Food Microbiol. 1993; 17(4) : 289-301.p Abstract: The effect of temperature, pH, sodium chloride concentration and a preservative (sodium benzoate, sodium nitrite or potassium sorbate) on the growth of three foodborne bacterial pathogens (Bacillus cereus, Vero cytotoxigenic Escherichia coli and Staphylococcus aureus) was studied using gradient gel plates. Growth, expressed in optical density units, was recorded using image analysis techniques, and was expressed as three-dimensional grids. These gave a visual indication of the effects of any three of the environmental factors on bacterial proliferation. Sorbate was completely effective against E. coli at all temperature/pH/NaCl combinations, and was the most effective preservative tested against B. cereus. Increase in the acidity and/or the NaCl concentration improved the effect of all the preservatives, except nitrite when used against St. aureus. Nitrite was the least effective preservative, particularly against St. aureus. At < 25 degrees C, sorbate was more effective than benzoate against St. aureus when used with higher concentrations of NaCl. At 35 degrees C benzoate was the most effective preservative against St. aureus, especially when used at pH < 6.

Thomson G.T. et al. *Immunoepidemiology of post-Salmonella reactive arthritis in a cohort of women.* Clin Immunol Immunopathol. 1992; 64(3) : 227-32.p Abstract: Following a foodborne outbreak of Salmonella dysentery in a group of 79 women and 4 men, 6 individuals were found to have reactive arthritis (ReA). None of the affected individuals had the classical genetic marker HLA B27 although 2 of the 6 had CREG antigens. IgA antibodies to the lipopolysaccharide of the causative organism, Salmonella heidelberg, were found to be elevated in those patients with active ReA compared to those with inactive ReA or those who had dysentery but did not develop ReA. The lymphocyte proliferative response to both PHA and the whole S. heidelberg organism was impaired in the patients with ReA (active or inactive) compared with the non-ReA patient controls. In this predominantly female outbreak of Salmonellosis, the development of ReA lacked an association with HLA class I antigens commonly recognized.

Tietjen M. et al. *Salmonellae and food safety.* Crit Rev Microbiol. 1995; 21(1) : 53-83.p Abstract: Salmonella is one of the most important foodborne pathogens around the world. The knowledge that very low numbers of Salmonella cells can be infectious emphasizes the need for stringent food safety measures Traditional methods for isolating and identifying Salmonella in food rely on preenrichment, selective enrichment in selective and differential media, biochemical tests, and serological confirmation. Recent advances in diagnostic technology have considerably altered testing methods for foodborne Salmonella. Many commercial assay systems and kits that use newer technologies are available to facilitate the identification of Salmonella in foods. These systems include miniaturized biochemical tests, new media formulations, automated instrumentation, DNA/RNA probes, antibody-dependent assays, and polymerase chain reaction. The technologies used for these systems are described, and the various kit formats are compared. Among the limitations of detection methods in terms of food safety are timeliness, limits of detection, and differentiation of virulent and nonvirulent isolates. Current efforts of prevention measures and strategies at different links of the food chain such as consumer education and hazard analysis and critical control point (HACCP) programs are reviewed, Global approaches to food safety are needed..

Todd E.C. *Epidemiology of foodborne diseases: a worldwide review.* World Health Stat Q. 1997; 50(1-2) : 30-50.p Abstract: Acute foodborne disease infections and intoxications are much more of a concern to governments and the food industry today than a few decades ago. Some of the factors that have led to this include the identification of new agents that have caused life-threatening conditions; the finding that traditional agents are being associated with foods that were of no concern previously: an increasing number of large outbreaks being reported; the impact of foodborne disease on children, the aging population and the immunocompromised; migrant populations demanding

their traditional foods in the countries of settlement; the ease of worldwide shipment of fresh and frozen food; and the development of new food industries, including aquaculture. However, to meaningfully monitor increases or decreases in foodborne disease requires an effective surveillance system at the local, national and international levels. To date, resources have been limited for most countries and regions to do this, and our current knowledge is based, for the most part, on passive reporting mechanisms. Laboratory isolation data and reports of notifiable diseases have some value in observing timely changes in case numbers of some enteric diseases, but they usually do not indicate the reasons for these trends. Special epidemiological studies are useful for the area covered, but it is often questionable whether they can be extrapolated to other areas or countries. Outbreak investigations tell us that a certain set of circumstances led to illness and that another outbreak may occur under similar but not necessarily identical conditions. Control programmes have often been triggered by the conclusions from investigations of specific outbreaks. Unfortunately, the agent/ food combination leading to illness in many of the reported incidents were not predicted from existing databases, and no doubt foodborne agents will continue to surprise food control agencies in the foreseeable future. Nevertheless, data from around the world do show some common elements. Salmonella is still the most important agent causing acute foodborne disease, with Salmonella enteritidis and S. typhimurium being of most concern. Foods of animal origin, particularly, meat and eggs, were most often implicated. Desserts, ice cream and confectionery items were products also mentioned, but some of these would have egg as a raw or incompletely cooked ingredient. Incidents most frequently occurred in homes or restaurants, and the main factors contributing to outbreaks were poor temperature control in preparing, cooking and storing food. Clostridium botulinum, Salmonella and VTEC are more frequently documented in industrialized than in developing countries. ETEC, EPEC, Shigella, Vibrio cholerae and parasites are the main scourges in developing countries, but it is uncertain how many cases are attributed to food, to water or to person-to-person transmission. The apparent decrease of S. aureus and C. perfringens outbreaks in industrialized countries may be related to improved temperature control in the kitchen. An increasing number of illnesses are international in scope, with contamination in a commercial product occurring in one country and affecting persons in several other countries, or tourists being infected abroad and possibly transmitting the pathogen to others at home. For Salmonella, a rapid alert and response coordination is being encouraged through Salm-Net and other international programs. However, unless such a network is worldwide, tracking clusters of illnesses is going to fall on the countries where the first cases occur, and some of these have very limited resources for investigation and control. It was heartening to see funds recently being allocated to foodborne disease surveillance and control in several industrialized countries, but the same commitment is required by the World Health Organization for the international community.

Tollefson L. et al. *Public health aspects of antibiotic resistance monitoring in the USA.* Acta Vet Scand Suppl. 1999; 92 : 67-75.p Abstract: Treatment of food-producing animals with antimicrobial agents that are important in human therapy may present a public health risk by the transfer of resistant zoonotic pathogens or resistant genes from animals to humans via consumption of contaminated food. Resistant bacteria can diminish the effectiveness of antibiotics and demand the use of more expensive or less safe alternatives. In 1996, the U. S. Food and Drug Administration (FDA), the Centers for Disease Control and Prevention (CDC), and the Department of Agriculture (USDA) established the National Antimicrobial Resistance Monitoring Program to prospectively monitor changes in antimicrobial susceptibilities of zoonotic enteric pathogens from human and animal clinical specimens, from healthy farm animals, and from carcasses of food-producing animals at slaughter plants. Data resulting from the monitoring program will be used to redirect antimicrobial drug use, primarily through educational initiatives directed at health practitioners, in order to diminish the development and spread of resistance. Veterinary testing is conducted at USDA's Agricultural Research Service and CDC's Foodborne Disease Laboratory is testing human isolates under contract to FDA. Both the CDC and USDA laboratories are using a semi-automated system (Sensititre, Accumed, Westlake, Ohio) for testing susceptibilities of the isolates to 17 antimicrobial agents on a minimum inhibitory concentration plate. Comparable methods for isolate handling are used in both laboratories. This paper describes the development, implementation, and objectives of the National Antimicrobial Resistance Monitoring Program, presents initial data generated by the program, and discusses future plans.

Tollefson L. et al. *Antibiotic use in food animals: controlling the human health impact.* J AOAC Int. 2000; 83(2) : 245-54.p Abstract: Resistance to antimicrobial drugs has compromised control of many bacterial pathogens. For foodborne pathogens, the most likely source of resistance is use of antimicrobials in food-producing animals. To control the human health impact from use of antimicrobials in animals, the U.S. Food and Drug Administration (FDA) recently announced plans to assess the microbial safety of all antimicrobials intended for use in food-producing animals. This paper describes the history of antimicrobial use and regulation in animals, the public health concern, the current animal drug approval process in the United States, the international perspective, and FDA's proposed procedures to evaluate the human health impact of the antimicrobial effects associated with animal drugs intended for use in food-producing animals. The primary public health goal of the improved regulatory paradigm is to ensure that significant human antimicrobial therapies are not lost due to use of antimicrobials in food animals.

Toriyama S. et al. *Characterization of a new picorna-like virus, himetobi P virus, in planthoppers.* J Gen Virol. 1992; 73 (Pt 4) : 1021-3.p Abstract: Picorna-like virus particles, 29 nm in diameter, were purified from apparently healthy

Laodelphax striatellus Fallen. The virus particles had a buoyant density of 1.352 g/ml in CsCl and a sedimentation coefficient of 161 s. The virus capsid proteins consisted of three major polypeptides of M(r)s 36,500, 33,000 and 28,000, and three minor polypeptides. The virus contained a major ssRNA of M(r) 2.8 x 10(6) and was also frequently associated with a minor dsRNA of M(r) 4 x 10(6). The 3' end of the ssRNA had a poly(A) tract of about 60 adenine residues. The virus has been provisionally named himetobi P virus.

Torok T.J. et al. *A large community outbreak of salmonellosis caused by intentional contamination of restaurant salad bars.* JAMA. 1997; 278(5) : 389-95.p Abstract: CONTEXT: This large outbreak of foodborne disease highlights the challenge of investigating outbreaks caused by intentional contamination and demonstrates the vulnerability of self-service foods to intentional contamination. OBJECTIVE: To investigate a large community outbreak of Salmonella Typhimurium infections. DESIGN: Epidemiologic investigation of patients with Salmonella gastroenteritis and possible exposures in The Dalles, Oregon. Cohort and case-control investigations were conducted among groups of restaurant patrons and employees to identify exposures associated with illness. SETTING: A community in Oregon. Outbreak period was September and October 1984. PATIENTS: A total of 751 persons with Salmonella gastroenteritis associated with eating or working at area restaurants. Most patients were identified through passive surveillance; active surveillance was conducted for selected groups. A case was defined either by clinical criteria or by a stool culture yielding S Typhimurium. RESULTS: The outbreak occurred in 2 waves, September 9 through 18 and September 19 through October 10. Most cases were associated with 10 restaurants, and epidemiologic studies of customers at 4 restaurants and of employees at all 10 restaurants implicated eating from salad bars as the major risk factor for infection. Eight (80%) of 10 affected restaurants compared with only 3 (11%) of the 28 other restaurants in The Dalles operated salad bars (relative risk, 7.5; 95% confidence interval, 2.4-22.7; P<.001). The implicated food items on the salad bars differed from one restaurant to another. The investigation did not identify any water supply, food item, supplier, or distributor common to all affected restaurants, nor were employees exposed to any single common source. In some instances, infected employees may have contributed to the spread of illness by inadvertently contaminating foods. However, no evidence was found linking ill employees to initiation of the outbreak. Errors in food rotation and inadequate refrigeration on ice-chilled salad bars may have facilitated growth of the S Typhimurium but could not have caused the outbreak. A subsequent criminal investigation revealed that members of a religious commune had deliberately contaminated the salad bars. An S Typhimurium strain found in a laboratory at the commune was indistinguishable from the outbreak strain. CONCLUSIONS: This outbreak of salmonellosis was caused by intentional contamination of restaurant salad bars by members of a religious commune.

Townes J.M. et al. *An outbreak of type A botulism associated with a commercial cheese sauce.* Ann Intern Med. 1996; 125(7) : 558-63.p Abstract: BACKGROUND: Although botulism is rare, recognition of a possible case of this illness represents a public health emergency. To prevent more cases, prompt investigation must be done to determine whether illness is linked to commercial product or restaurant. Botulism can masquerade as other illnesses, and seemingly unlikely foods can harbor botulinum toxin. OBJECTIVE: To confirm the diagnosis and determine the cause and extent of an outbreak of botulism associated with food served at a delicatessen. DESIGN: Retrospective cohort study of patrons of the delicatessen; laboratory analysis of food, serum samples, and stool samples; and traceback of implicated food. SETTING: Community in Georgia. PARTICIPANTS: Patrons of the delicatessen. MAIN OUTCOME MEASURES: Botulinum toxin in food, serum, or stool and Clostridium botulinum in food and stools. RESULTS: 8 of 52 patrons (15%) met the case definition for botulism. In 4 of the 8 patrons, and illness other than botulism was initially diagnosed. Five of the 8 were hospitalized, and 1 died. Stool cultures from 4 patrons yielded type AC. botulinum, and two serum samples contained botulinum toxin. All ill persons ate food from the delicatessen on 1 October 1993. Of the 22 persons who ate at the delicatessen that day, all 8 ill persons but none of the 14 well persons ate a potato stuffed with meat and cheese sauce. An open can of cheese sauce contained type A botulinum toxin and yielded C botulinum on culture. Cheese sauce experimentally inoculated with C botulinum spores became toxic after 8 days at a temperature of 22 degrees C (room temperature). CONCLUSIONS: A commercial, canned cheese caused a botulism outbreak. This product readily becomes toxic when contaminated by C botulinum spores and left at room temperature. Mild botulism caused by unusual vehicles may be misdiagnosed. Botulism should be included in the differential diagnosis of persons with signs or symptoms of acute cranial nerve dysfunction.

Townsend D.E. et al. *Comparison of SimPlate Total Plate Count test with plate count agar method for detection and quantitation of bacteria in food.* J AOAC Int. 1998; 81(3) : 563-9.p Abstract: The SimPlate Total Plate Count (TPC) test, developed by IDEXX Laboratories, Inc., detects and quantitates total bacterial concentration in food after 24 h of incubation. The performance of SimPlate TPC was compared with that of the plate count agar (PCA) method for enumerating total bacterial concentration of 255 food samples representing 15 different food matrixes. Total bacterial counts on SimPlate TPC were measured after 24 h of incubation and plotted against values obtained from PCA after 48 h. Simple regression analysis of the data showed strong correlation between the methods (r = 0.95); the sensitivity of SimPlate TPC for foodborne bacteria was 96% relative to PCA (slope = 0.96). It was concluded that SimPlate TPC is a suitable alternative for the detection and quantitation of foodborne bacteria. The method has been

granted Performance Tested Certification by the AOAC Research Institute.

Troutt H.F. et al. *Meat from dairy cows: possible microbiological hazards and risks.* Rev Sci Tech. 1997; 16(2) : 405-14.p Abstract: The authors provide an overview of the circumstances associated with culling of dairy cattle in the United States of America (USA) and focus on the possible significant microbiological hazards associated with meat from cull dairy cows. Cull dairy cows are an important source of food in the USA, accounting for at least approximately 17% of ground beef. The potential microbiological hazards for foodborne illness from cull dairy cows discussed here include Salmonella (with special attention to S. Typhimurium DT104), Escherichia coli O157:H7, Campylobacter jejuni, Listeria monocytogenes, Clostridium perfringens and Staphylococcus aureus. Possible sources and means of contamination are pointed out, as are the potential foodborne risks from Bacillus cereus and Aeromonas spp. In conclusion, widespread microbiological studies are needed to determine the prevalence and risk of foodborne pathogens in cull dairy cattle.

Tuttle J. et al. *Lessons from a large outbreak of Escherichia coli O157:H7 infections: insights into the infectious dose and method of widespread contamination of hamburger patties.* Epidemiol Infect. 1999; 122(2) : 185-92.p Abstract: Between November 1992 and February 1993, a large outbreak of Escherichia coli O157:H7 infections occurred in the western USA and was associated with eating ground beef patties at restaurants of one fast-food chain. Restaurants that were epidemiologically linked with cases served patties produced on two consecutive dates; cultures of recalled ground beef patties produced on those dates yielded E. coli O157:H7 strains indistinguishable from those isolated from patients, confirming the vehicle of illness. Seventy-six ground beef patty samples were cultured quantitatively for E. coli O157:H7. The median most probable number of organisms was 1.5 per gram (range, < 0.3-15) or 67.5 organisms per patty (range, < 13.5-675). Correlation of the presence of E. coli O157:H7 with other bacterial indicators yielded a significant association between coliform count and the presence of E. coli O157:H7 (P = 0.04). A meat traceback to investigate possible sources of contamination revealed cattle were probably initially colonized with E. coli O157:H7, and that their slaughter caused surface contamination of meat, which once combined with meat from other sources, resulted in a large number of contaminated ground beef patties. Microbiological testing of meat from lots consumed by persons who became ill was suggestive of an infectious dose for E. coli O157:H7 of fewer than 700 organisms. These findings present a strong argument for enforcing zero tolerance for this organism in processed food and for markedly decreasing contamination of raw ground beef. Process controls that incorporate microbiological testing of meat may assist these efforts.

U

Ultee A. et al. *Antimicrobial activity of carvacrol toward Bacillus cereus on rice.* J Food Prot. 2000; 63(5) : 620-4.p Abstract: The antimicrobial activity of carvacrol, a compound present in the essential oil fraction of oreganum and thyme, toward the foodborne pathogen Bacillus cereus on rice was studied. Carvacrol showed a dose-related inhibition of growth of the pathogen. Concentrations of 0.15 mg/g and higher inhibited the growth and the extent of inhibition depended on the initial inoculum size. To decrease the input of carvacrol on the taste and flavor of the product, a combined treatment with the structure analog cymene was tested. Due to the smell and taste of carvacrol at high concentrations, carvacrol was combined with cymene, a natural antimicrobial compound with a similar structure. A synergistic effect was observed when 0.30 mg/g carvacrol was combined with 0.27 mg/g cymene. Finally it was demonstrated that a common taste enhancer like soya sauce also increased the antimicrobial action of carvacrol toward B. cereus. The antimicrobial activity of carvacrol with cymene or soya sauce was influenced by the addition of NaCl.

Untermann F. *[Problems of food hygiene with carriers of microorganisms and permanent excretors].* Zentralbl Hyg Umweltmed. 1993; 194(1-2) : 197-204.p Abstract: To appraise the significance of chronic excretors and carriers for the development of "food poisoning", the analysis must also include the food. First of all, the question arises as to whether foods only have a vector function or whether an increase in the bacterial count is an important prerequisite for the elicitation of human disease. When pure intoxication pathogens are not involved, this question arises in connection with the minimum infectious dose. A classification of the most important causative organisms of bacterial foodborne infections and intoxications is presented in the light of these considerations. If foods only have a vector function, hygiene measures are automatically concentrated on excretors in order to prevent the bacteria from passing into foods. When this is not the case (as in the vast majority of human foodborne infections and intoxications of bacterial origin), two strategies can be successfully applied. First of all, precautions must be taken to rule out bacterial contamination. On the other hand, an increase in the bacterial count, i.e. proliferation of the pathogens in the food must be prevented by appropriate measures. The interacting factors are described. The example of salmonellae is cited to illustrate the routes of contamination from excretors (humans and animals) to foods ready for consumption and possible hygiene measures.

Untermann F. *[Risk assessment of microorganisms relevant to food hygiene].* Zentralbl Hyg Umweltmed. 1995; 197(1-3) : 222-31.p Abstract: In the public's view, chemical residues still dominate in the ranking of foodborne hazards. This perception is changing slowly as a result of public discussions on the dangers to human beings from various

microorganisms in foodstuff. Statistics on foodborne infections and intoxications comprising acute diseases have shown that chemical substances (including fungal toxins) play a less significant role than bacteria. A sentinel and a populations study from Holland provides information on the incidence of cases of acute gastroenteritis caused by microorganisms in foods. The results of this study show that 100 to 150 cases are to be expected annually per 1000 inhabitants. An economic cost of about $1000 per case of disease is calculated in Canada and the USA. On the basis of these figures and the Dutch study, the estimated annual economic impact is more than 10 billion DM for the Federal Republic of Germany. The difficulties in quantification of microbiological hazards from foodstuffs on the base of dose-response relation and exposure assessment such as are usual in the risk assessment of chemical hazards are discussed. A safety concept of the food industry (the HACCP concept) is then described. This comprises hazard identification. risk assessment as well as risk management. This concept is also applicable in other food areas such as communal catering. In the meantime, it has also been taken into consideration in European food legislation.

Usera M.A. et al. *Interregional foodborne salmonellosis outbreak due to powdered infant formula contaminated with lactose-fermenting Salmonella virchow.* Eur J Epidemiol. 1996; 12(4) : 377-81.p Abstract: Spain's Salmonella surveillance system backed by regionally-based epidemiologists around the country made it possible to detect and halt the spread of a foodborne salmonellosis outbreak due to powdered infant formula contaminated with a lactose-fermenting strain of Salmonella virchow. Forty-eight cases involving children, mostly under 7 months old, were detected in 14 out of Spain's 17 Regions. The outbreak started in January and ended in June 1994. All cases were microbiologically confirmed. The implicated strain had a 3.6 kb plasmid, was susceptible to all antimicrobials tested except nitrofurantoin and was phagetype 4a. Isolates from 8 of 24 Brand "A" milk samples tested had the same characteristics as case isolates. All affected/suspect batches of Brand "A" milk were destroyed and the product withdrawn from sale, which led to the end of the outbreak. This incident underscores the importance of maintaining surveillance systems able to detect and prevent foodborne outbreaks and alert to the possibility of isolating unusual lactose-fermenting Salmonella serotypes in especially sensitive food products.

Usera M.A. et al. *Molecular subtyping of Vibrio cholerae O1 strains recently isolated from patient, food and environmental samples in Spain.* Eur J Clin Microbiol Infect Dis. 1994; 13(4) : 299-303.p Abstract: Nineteen Vibrio cholerae O1 strains isolated in Spain from patient, food and environmental samples in the period 1990-1992 were characterized by detection of cholera toxin by enzyme immunoassay, detection of cholera toxin gene by polymerase chain reaction, and by biotyping, ribotyping and pulsed-field gel electrophoresis. Ten isolates were toxigenic and were further characterized by multilocus enzyme electrophoresis. Molecular subtyping methods allowed precise differentiation between isolates, indicating their geographic origin. Isolates associated with the ongoing seventh pandemic were distinguishable from those associated with the present Latin American epidemic. All isolates from the environment and seafood were nontoxigenic, and were genetically different and more diverse than toxigenic isolates. The data suggest that a focus of endemic cholera does not exist in Spain, and that the analyzed nontoxigenic Vibrio cholerae O1 isolates from imported seafood were not a threat to public health.

Usera M.A. et al. *Multiple analysis of a foodborne outbreak caused by infant formula contaminated by an atypical Salmonella virchow strain.* Eur J Clin Microbiol Infect Dis. 1998; 17(8) : 551-5.p Abstract: An outbreak of food poisoning involving most autonomous Spanish communities was detected in the first half of 1994. The causative food was infant formula milk contaminated by lactose-fermenting Salmonella virchow. It was not possible to isolate the causative strain from the manufacturer's facilities. During the same period of time, there was a significant increase in lactose-non-fermenting Salmonella virchow strains compared with the same period in previous years. Simultaneously, lactose-non-fermenting strains were recovered from clinical samples from children and from some milk samples that were involved in the outbreak. Therefore, it was speculated that the outbreak might be more extensive than initially thought. The following epidemiological markers were used for typing the Salmonella virchow strains involved in the outbreak: (i) phage typing: (ii) ribotyping, using a set of 20 different endonucleases: and (iii) pulsed-field gel electrophoresis, using three different endonucleases. The most useful markers for this serotype were phage typing and pulsed-field gel electrophoresis, since ribotyping was not able to distinguish all strains tested. The results obtained revealed that the outbreak was caused by at least two strains: one presenting phage type 4-4a and pulsed-field patterns A1 or A2 and L+ or L-, and another presenting phage type 2 and pulsed-field patterns A1 or A2 and L+ or L-. The results indicate that the outbreak was more extensive than initially thought and that the Virchow serotype is very clonal in Spain.

V

van den Heuvel J.F. et al. *Characteristics of acyrthosiphon pisum virus, a newly identified virus infecting the pea aphid.* J Invertebr Pathol. 1997; 70(3) : 169-76.p Abstract: A new virus was isolated from the pea aphid, Acyrthosiphon pisum, and tentatively named Acyrthosiphon pisum virus (APV). The isometric virus particles were approximately 31 nm in diameter and contained a single-stranded RNA molecule of approximately 10 kb. Four structural proteins were observed with molecular masses of approximately 23.3, 24.2, 34.5, and 66.2 kDa. The 34.5-kDa capsid protein was the most abundant product in purified virions. Computer-

assisted analysis revealed no significant homology between an internal sequence of 37 amino acids of the 34.5-kDa protein of APV and other polypeptides of viral origin. APV was not immunologically related to other ssRNA viruses from hemipteroid insects, such as aphid lethal paralysis virus, Rhopalosiphum padi virus, and Nezara viridula virus type 1. Immunolocalization on ultrathin sections of 3-day-old nymphs of A. pisum showed that APV antigen was predominantly present in the epithelial cells of the digestive tract. Virus particles were also observed associated with the microvilli of the intestine. Occasionally, muscle cells and mycetocyte cells were found infected. Purified APV, fed to 1-day-old A. pisum nymphs, significantly reduced the growth of the aphid and increased the time needed to reach maturity.

van der Wilk F. et al. *Isolation and characterization of APSE-1, a bacteriophage infecting the secondary endosymbiont of Acyrthosiphon pisum.* Virology. 1999; 262(1) : 104-13.p Abstract: A bacteriophage infecting the secondary endosymbiont of the pea aphid Acyrthosiphon pisum was isolated and characterized. The phage was tentatively named bacteriophage APSE-1, for bacteriophage 1 of the A. pisum secondary endosymbiont. The APSE-1 phage particles morphologically resembled those of species of the Podoviridae. The complete nucleotide sequence of the bacteriophage APSE-1 genome was elucidated, and its genomic organization was deduced. The genome consists of a circularly permuted and terminally redundant double-stranded DNA molecule of 36524 bp. Fifty-four open reading frames, putatively encoding proteins with molecular masses of more than 8 kDa, were distinguished. ORF24 was identified as the gene coding for the major head protein by N-terminal amino acid sequencing of the protein. Comparison of APSE-1 sequences with bacteriophage-derived sequences present in databases revealed the putative function of 24 products, including the lysis proteins, scaffolding protein, transfer proteins, and DNA polymerase. This is the first report of a phage infecting an endosymbiont of an arthropod. Copyright 1999 Academic Press.

van der Wolf P.J. et al. *Salmonella infections in finishing pigs in The Netherlands: bacteriological herd prevalence, serogroup and antibiotic resistance of isolates and risk factors for infection.* Vet Microbiol. 1999; 67(4) : 263-75.p Abstract: Salmonellae are wide spread in man and animals world wide and are of increasing significance as causative agents of foodborne diseases in man. The European Union, national authorities and the pig industry are therefore more and more interested in the Salmonella status of the pig population. The aim of this study was to estimate the bacteriological prevalence of Salmonella in finishing pig herds, the serogroup and the resistance to antibiotics of the isolated Salmonellae and a preliminary risk analysis of factors associated with infection. For this, 317 finishing pig herds were randomly selected from a database containing 1500 herds in the southern part of the Netherlands. In each herd 24 samples of fresh faeces were collected from two compartments with pigs close to market weight. Per compartment 12 samples of faeces were pooled into one pooled sample. Pooled samples were cultured in duplicate. Salmonella spp. were recovered from 71 out of 306 herds (23%) in which two compartments could be sampled. A total of 108 isolated Salmonella's were serotyped: 71 serogroup B, 3 serogroup C1, 6 serogroup C2, 22 serogroup D1, and 6 isolates neither serogroup B, C or D1. Of a total of 115 Salmonella isolates tested, none were resistant to colistin, enrofloxacin, flumequin or gentamicin. Automated liquid feeding of by-products, and membership of an Integrated Quality Control (IQC) production group were associated with a decreased risk of infection, while use of trough feeding was associated with an increased risk of infection. It is necessary to test these presumed risk factors in intervention studies to evaluate their potency to reduce the Salmonella prevalence in finishing pigs and thereby reduce the risk of Salmonellosis in people consuming pork.

van Gerwen S.J. et al. *An identification procedure for foodborne microbial hazards.* Int J Food Microbiol. 1997; 38(1) : 1-15.p Abstract: A stepwise and interactive identification procedure for foodborne microbial hazards has been developed in which use is made of several levels of detail ranging from rough hazard identification to comprehensive hazard identification. This approach allows one to tackle the most obvious hazards first, before focusing on less obvious hazards. The interactive character of the identification procedure is based on the use of several knowledge sources. Combination of knowledge sources, expressed in the use of knowledge rules, supports the user in systematically selecting hazards which may pose a real risk to the consumer. Due to the structured method and the clear definitions of the knowledge rules, the procedure is transparent and may be changed if necessary. The hazard identification procedure has been implemented as a computer program, resulting in a decision-supporting identification system. It provides a way to efficiently assess those hazards which may cause harm if not brought under control during processing. The procedure forms a basis for quantitative risk assessments.

VanDerslice J. et al. *Drinking-water quality, sanitation, and breast-feeding: their interactive effects on infant health.* Bull World Health Organ. 1994; 72(4) : 589-601.p Abstract: The promotion of proper infant feeding practices and the improvement of environmental sanitation have been two important strategies in the effort to reduce diarrhoeal morbidity among infants. Breast-feeding protects infants by decreasing their exposure to water- and foodborne pathogens and by improving their resistance to infection; good sanitation isolates faecal material from the human environment, reducing exposures to enteric pathogens. Taken together, breast-feeding and good sanitation form a set of sequential barriers that protect infants from diarrhoeal pathogens. As a result, breast-feeding may be most important if the sanitation barrier is not in place. This issue is explored using data from a prospective study of 2355 urban Filipino infants during the first 6 months of life. Longitudinal multivariate analyses

are used to estimate the effects of full breast-feeding and mixed feeding on diarrhoeal disease at different levels of sanitation. Breast-feeding provides significant protection against diarrhoeal disease for infants in all environments. Administration of even small portions of contaminated water supplements to fully breast-fed infants nearly doubles their risk of diarrhoea. Mixed-fed and weaned infants consume much greater quantities of supplemental liquids, and as a result, the protective effect of full breast-feeding is greatest when drinking-water is contaminated. Similarly, full breast-feeding has stronger protective effects among infants living in crowded, highly contaminated settings.

Vasavada P.C. *Rapid methods and automation in dairy microbiology.* J Dairy Sci. 1993; 76(10) : 3101-13.p Abstract: The importance of microbiology to the dairy industry has been demonstrated by recent outbreaks of foodborne illness associated with consumption of milk and dairy products that had been contaminated with pathogenic organisms or toxins. Undesirable microorganisms constitute the primary hazard to safety, quality, and wholesomeness of milk and dairy foods. Consequently, increased emphasis has been placed on the microbiological analysis of milk and dairy products designed to evaluate quality and to ensure safety and regulatory compliance. The focus of dairy microbiology, however, remains largely on conventional methods: plate counts, most probable numbers, and dye reduction tests. These methods are slow, tedious, intensive in their requirements for material and labor, and often not suitable for assessing the quality and shelf-life of perishable dairy foods. With the exception of coliforms, Salmonella, and Staphylococcus aureus, isolation and characterization of various organisms occurring in milk and milk products are seldom a part of the routine microbiological analysis in the dairy industry. Recent emphasis on the programs based on HACCP (Hazard Analysis and Critical Control Points) for total quality management in the dairy industry and increased demand for microbiological surveillance of products, process, and environment have led to increased interest in rapid methods and automation in microbiology. Several methods for rapid detection, isolation, enumeration, and characterization of microorganisms are being adapted by the dairy industry. This presentation reviews rapid methods and automation in microbiology for microbiological analysis of milk and dairy products.

Vazquez L.L. et al. *[Host plants of Bemisia tabaci (Homoptera: Aleyrodidae) in Cuba].* Rev Biol Trop. 1997; 44-45 : 143-8.p Abstract: The sweet potato white fly, Bemisia tabaci, is an important pest of tomatoes and beans, among other crops, which transmits viral diseases. Since the second quarter of 1989 a significant population increase of this pest has been noted in several cultivated plants. From 1989 to 1992, a survey was done throughout the country, chiefly in vegetable and bean-producing areas. They occur in 119 species (42 families), a great increase over the previous record of four species. Worldwide, this report represents 50 species and six families which are new records.

Velazquez M. et al. *Helicobacter pylori: characteristics, pathogenicity, detection methods and mode of transmission implicating foods and water.* Int J Food Microbiol. 1999; 53(2-3) : 95-104.p Abstract: Helicobacter pylori is an organism involved in the pathogenesis of human active chronic gastritis, peptic and duodenal ulcer diseases and gastric cancer. This review article covers this emerging human pathogen in terms of its phenotypic and genotypic characteristics, methods for culturing, its role in gastric pathogenicity, evidence involving its mode of transmission, difficulty in its isolation and detection methodology. In terms of transmission, both foodborne and waterborne pathways have been speculated as the mode of transmission for H. pylori as the patterns of the infection are consistent with those from fecal-oral and oral-oral transmission. Therefore, it is important to also evaluate methods for the detection of H. pylori from specifically food products and water. The detection of this pathogen has proved difficult since changes in cell morphology, metabolism and growth patterns occur when H. pylori is exposed to different environmental stimuli. The development of a viable but non-culturable coccoid (VNC) form is observed. These VNC forms do not undergo cellular division and cannot be cultured by traditional methods, increasing the difficulty in their detection. Since both viability and virulence in the VNC form of H. pylori are retained, the examination of food products and water for these forms is critical. Current methods include filtration, immuno-separation (IMS), polymerase chain reaction (PCR), probe hybridization, immuno-staining, autoradiography and ATP bioluminescence.

Vellema P. et al. *The effect of cobalt supplementation on the immune response in vitamin B12 deficient Texel lambs.* Vet Immunol Immunopathol. 1996; 55(1-3) : 151-61.p Abstract: The effect of cobalt supplementation on the immune reactivity in vitamin B12 deficient lambs was measured by comparing the humoral and cell-mediated immune responses against bovine herpes virus type 1 and Mycobacterium paratuberculosis. In addition, faecal egg counts were performed after natural infection with gastrointestinal nematodes. The experiments were performed with registered Texel twin lambs of the same sex. One lamb of each twin received three cobalt pellets divided over the grazing period. The non-supplemented lambs had lower serum vitamin B12 levels than their supplemented brother or sister. Our results demonstrate significantly lower lymphoblastic responses against Mycobacterium paratuberculosis in non-supplemented lambs compared with supplemented lambs 4 weeks after paratuberculosis vaccination. Vitamin B12 deficient lambs in this study had significant higher faecal egg counts than their supplemented brother or sister after natural infection with gastrointestinal nematodes. No differences were found in total and differential white blood cell counts, in total protein, albumin, alpha-, beta- and gamma-globulin and in antibody production against bovine herpes virus type 1 and Mycobacterium paratuberculosis.

Villar R.G. et al. *Investigation of multidrug-resistant Salmonella serotype typhimurium DT104 infections linked to raw-milk cheese in Washington State.* JAMA. 1999; 281(19) : 1811-6.p Abstract: CONTEXT: Multidrug-resistant Salmonella Typhimurium DT104 has recently emerged as a cause of human and animal illness in Europe and North America. In early 1997, health officials in Yakima County, Washington, noted a 5-fold increase in salmonellosis among the county's Hispanic population. OBJECTIVES: To characterize bacterial strains and identify risk factors for infection with Salmonella Typhimurium in Yakima County. DESIGN: Laboratory, case-control, and environmental investigations. SETTING AND PARTICIPANTS: Patients with culture-confirmed Salmonella Typhimurium infection living in Yakima County and age- and neighborhood-matched control subjects. MAIN OUTCOME MEASURES: Food vehicle implication based on case-control study and outbreak control. RESULTS: Between January 1 and May 5, 1997, 54 culture-confirmed cases of Salmonella Typhimurium were reported. The median age of patients was 4 years and 91% were Hispanic. Patients reported diarrhea (100%), abdominal cramps (93%), fever (93%), bloody stools (72%), and vomiting (53%); 5 patients (9%) were hospitalized. Twenty-two patients and 61 control subjects were enrolled in the case-control study. Seventeen case patients (77%) reported eating unpasteurized Mexican-style soft cheese in the 7 days before onset of illness compared with 17 control subjects (28%) (matched odds ratio, 32.3; 95% confidence interval, 3.0-874.6). All case-patient isolates were phage definitive type 104 (DT104) (n = 10) or DT104b (n = 12), and 20 (91%) were resistant to ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline. The cheese produced and eaten by 2 unrelated patients was made with raw milk traced to the same local farm. Milk samples from nearby dairies yielded Salmonella Typhimurium DT104. The incidence of Salmonella Typhimurium infections in Yakima County returned to pre-1992 levels following interventions based on these findings. CONCLUSIONS: Multidrug-resistant Salmonella Typhimurium DT104 emerged as a cause of salmonellosis in Yakima County, and Mexican-style soft cheese made with unpasteurized milk is an important vehicle for Salmonella Typhimurium DT104 transmission. We postulate that recent increases in human salmonellosis reflect the emergence of Salmonella Typhimurium DT104 among dairy cows in the region. Continued efforts are needed to discourage consumption of raw milk products, promote healthier alternatives, and study the ecology of multidrug-resistant Salmonella Typhimurium.

Villar R.G. et al. *Outbreak of type A botulism and development of a botulism surveillance and antitoxin release system in Argentina.* JAMA. 1999; 281(14) : 1334-8, 1340.p Abstract: CONTEXT: Botulism is an important public health problem in Argentina, but obtaining antitoxin rapidly has been difficult because global supplies are limited. In January 1998, a botulism outbreak occurred in Buenos Aires. OBJECTIVES: To determine the source of the outbreak, improve botulism surveillance, and establish an antitoxin supply and release system in Argentina. DESIGN, SETTING, AND PARTICIPANTS: Cohort study in January 1998 of 21 drivers of a specific bus route in urban Buenos Aires. MAIN OUTCOME MEASURE: Occurrence of botulism and implication of a particular food as the vehicle causing this outbreak. RESULTS: Nine (43%) of 21 bus drivers developed botulism, presenting with gastroenteritis, symptoms of acute cranial nerve dysfunction including ptosis, dysphagia, blurred vision, and motor weakness. One driver experienced respiratory failure. Type A toxin was detected from 3 of 9 patients' serum samples. All drivers received botulism antitoxin; there were no fatalities. Consumption of matambre (Argentine meat roll) was significantly associated with illness. Among 11 persons who ate matambre, 9 developed illness, compared with none of those who did not eat it (P<.001). The matambre had been cooked in water at 78 degrees C to 80 degrees C for 4 hours, sealed in heat-shrinked plastic wrap, and stored in refrigerators that did not cool adequately. Subsequently, a botulism surveillance and antitoxin release system was established. CONCLUSIONS: Insufficient cooking time and temperatures, storage in heat-shrinked plastic wrap, and inadequate refrigeration likely contributed to Clostridium botulinum spore survival, germination, and toxin production. A rapid-response botulism surveillance and antitoxin release system in Argentina should provide more timely distribution of antitoxin to patients and may serve as a model for other nations.

Voetz N. *[Guarantee of the control of animal epidemics for consumer protection].* DTW Dtsch Tierarztl Wochenschr. 1994; 101(7) : 272-4.p Abstract: The main of animal disease control with regard to consumer welfare is the eradication of zoonoses, that is of zoonotic agent that, via food of animal origin, cause disease in man. As an example of harmonized European Union control measures reference is made to Directive 92/117/EEC concerning measures for protection against specified zoonoses and specified zoonotic agents in animals and products of animal origin in order to prevent outbreaks of foodborne infections and intoxications (Zoonosis Directive), with an emphasis on salmonellosis in poultry flocks. The commitment of EU member states to the improvement of the health status of farm animals, to the reduction of threats to human health, and to simultaneously guaranteeing free intra-Community trade results in the need to reorganise veterinary services.

W

Wachsmuth I.K. et al. *The use of plasmid profiles and nucleic acid probes in epidemiologic investigations of foodborne, diarrheal diseases.* Int J Food Microbiol. 1991; 12(1) : 77-89.p Abstract: The application of nucleic acid analyses to investigations of infectious disease outbreaks has resulted in useful molecular strain markers that distinguish the epidemic clone of a particular pathogen and help identify specific vehicles of infection. We have successfully used plasmid profile analysis, restriction endonuclease digestion

of plasmid and whole-cell DNAs, and nucleic acid hybridization to investigate recent outbreaks of foodborne diarrheal illness. Plasmid analysis has been important in identifying epidemic strains of Salmonella enteritidis and Escherichia coli O157:H7. In a culture survey of S. enteritidis isolates from humans and a variety of animals, including chickens and chicken eggs, we identified 16 distinct plasmid profiles and used these to differentiate strains, especially within commonly occurring phage types (Colindale 8 and 13a). HindIII digests of plasmid DNA were useful in distinguishing plasmids of similar mass but dissimilar enzyme target sequences; they clearly distinguished S. enteritidis strains causing systemic infections in children in parts of Africa from U.S. isolates. Investigations of outbreaks of hemorrhagic colitis have also been assisted by plasmid analysis. Restriction endonuclease digests of whole-cell DNA and Southern blot analysis, hybridizing with E. coli 16S and 23S rRNA (ribotyping), have been effective subtyping techniques, especially for plasmidless isolates of Campylobacter jejuni. In five outbreaks of C. jejuni infections, ribotyping of PvuII and ClaI digests distinguished individual epidemic strains within one commonly occurring C. jejuni serotype (Penner 2, Lior 4). Preliminary data show that ribotyping of NcoI digests can also distinguish individual epidemic strains of E. coli O157:H7 and may provide a more stable marker than plasmid profiles. Specific DNA probes derived from cloned virulence genes of E. coli have been invaluable in epidemic investigations and surveys. Using colony hybridization, we found in one survey of stool specimens from 174 dairy cattle that 11% of animals were asymptomatically carrying Shiga-like toxigenic E. coli other than O157:H7. We also found that newly synthesized oligonucleotide probes for the Shiga-like toxins I and II agreed 100% with cloned gene probes in a study of 613 E. coli strains. Future studies of these organisms will include the use of additional synthetic oligonucleotides as primers to amplify the toxin genes directly in patient and animal specimens by the polymerase chain reaction. There is a continuing and expanding role for molecular approaches in epidemiological investigations. The DNA methods described above are not based on the often complex expression of phenotypic characteristics, and, unlike sensitive and specific techniques such as phage typing, a single method can be used to study a variety of Gram-positive and negative bacterial pathogens.

Wagner M. et al. *Single-strand conformation polymorphisms in the hly gene and polymerase chain reaction analysis of a repeat region in the iap gene to identify and type Listeria monocytogenes.* J Food Prot. 2000; 63(3) : 332-6.p
Abstract: Two novel methods that allow the powerful identification of Listeria monocytogenes by polymerase chain reaction (PCR) and simultaneous differentiation by special electrophoresis formats are described. The first method involves a PCR-driven single-strand conformation polymorphism (SSCP-PCR) assay using a portion of the noncoding region of the hlv gene. The assay was evaluated with 120 genetically distinct L. monocytogenes strains of either foodborne or clinical origin. Distribution of listerial strains to at least 14 SSCP types was observed. In respect to the panel of strains, 39.7% were assigned to SSCP type 3, and 19% showed SSCP type 5. Further, SSCP type 1 was found in 7.5% of all strains, SSCP type 10 in 6.7%, and 5.8% each for SSCP types 6 and 7. The SSCP types 4, 9, and 11 were infrequently described in 2.55%, 3.3%, and 4.2%, respectively, of all isolates. At least 0.85% represented each of the SSCP types 2, 13, and 14, and 1.7% displayed SSCP types 8 and 12. In the second method, the internal threonine-asparagine repeat portion of the L. monocytogenes p60 protein was used for setting up a PCR-based identification and parallel differentiation assay. Ten different repeat types (RTs), according to different sizes of PCR products, were observed. Of 163 strains tested, 35.58% of samples were assigned to RT 1, 39.26% to RT 2, 3.68% to RT 3, 6.13% to RT 4, 4.29% to RT 5, 2.45% to RT 6, 5.52% to RT 7, 0.61% to RT 8, 0.61% to RT 9, and 1.83% to RT 10. The data suggest that both methods allow the simple identification and differentiation of L. monocytogenes isolates. Therefore, both the SSCP-PCR and the PCR-based identification and parallel differentiation assay could represent single-strand pretyping assays before laborious reference typing methods are applied.

Wallace B.J. et al. *Seafood-associated disease outbreaks in New York, 1980-1994.* Am J Prev Med. 1999; 17(1) : 48-54.p
Abstract: BACKGROUND: Seafood-associated disease outbreaks in New York were examined to describe their epidemiology and to identify areas for prevention and control efforts. METHODS: We reviewed reports submitted to the New York State Department of Health (NYSDOH) of seafood-associated outbreaks occurring from January 1, 1980, through December 31, 1994. RESULTS: During 1980-1994, 339 seafood-associated outbreaks were reported, resulting in 3959 illnesses, 76 hospitalizations, and 4 deaths. During this period, seafood-associated outbreaks accounted for 19% of all reported foodborne outbreaks and 10% of foodborne illnesses. Shellfish, the most frequently implicated seafood item, accounted for 64% of seafood outbreaks, followed by finfish (31% of outbreaks). Of the 148 seafood-associated outbreaks with a confirmed etiologic agent, Norwalk virus and scombrotoxin were the most frequently identified agents: Norwalk virus accounted for 42% of outbreaks and 42% of illnesses, and scombrotoxin accounted for 44% of outbreaks and 19% of illnesses. Three of the 4 seafood-associated deaths were caused by Clostridium botulinum; the remaining death was caused by Vibrio vulnificus. CONCLUSIONS: Reducing the number of seafood outbreaks will require continued and coordinated efforts by many different agencies, including those involved with water quality; disease surveillance; consumer education; and seafood harvesting, processing, and marketing. New York's foodborne disease surveillance data highlight potential areas on which to focus prevention efforts, including: (1) commodities and associated pathogens causing the largest number of seafood-associated outbreaks and illnesses, namely shellfish-associated viral gastroenteritis and finfish-associated scombroid fish poisoning, and (2) venues at which seafood were most

frequently consumed in reported outbreaks, such as commercial food establishments and catered events.

Wallace D.J. et al. *Incidence of foodborne illnesses reported by the foodborne diseases active surveillance network (FoodNet)-1997. FoodNet Working Group.* J Food Prot. 2000; 63(6) : 807-9.p Abstract: In 1997, the Foodborne Diseases Active Surveillance Program (FoodNet) conducted active surveillance for culture-confirmed cases of Campylobacter, Escherichia coli O157, Listeria, Salmonella, Shigella, Vibrio, Yersinia, Cyclospora, and Cryptosporidium in five Emerging Infections Program sites. FoodNet is a collaborative effort of the Centers for Disease Control and Prevention's National Center for Infectious Diseases, the United States Department of Agriculture's Food Safety and Inspection Service, the Food and Drug Administration's Center for Food Safety and Applied Nutrition, and state health departments in California, Connecticut, Georgia, Minnesota, and Oregon. The population under active surveillance for foodborne infections was approximately 16.1 million persons or roughly 6% of the United States Population. Through weekly or monthly contact with all clinical laboratories in these sites, 8,576 total isolations were recorded: 2,205 cases of salmonellosis, 1,273 cases of shigellosis, 468 cases of cryptosporidiosis, 340 of E. coli O157:H7 infections, 139 of yersiniosis, 77 of listeriosis, 51 of Vibrio infections, and 49 of cyclosporiasis. Results from 1997 demonstrate that while there are regional and seasonal differences in reported incidence rates of certain bacterial and parasitic diseases, and that some pathogens showed a change in incidence from 1996, the overall incidence of illness caused by pathogens under surveillance was stable. More data over more years are needed to assess if observed variations in incidence reflect yearly fluctuations or true changes in the burden of foodborne illness.

Waller P.J. et al. *The prospects for biological control of the free-living stages of nematode parasites of livestock.* Int J Parasitol. 1996; 26(8-9) : 915-25.p Abstract: Control of nematode parasites of livestock is focused almost entirely on the parasitic stages within the host. Current methods rely on anthelmintic drugs, but these are under increasing threat with the development of resistance covering the whole spectrum of anthelmintics amongst the important nematode species of a range of livestock. However, invariably the greatest proportion of the parasite biomass resides not within the animal hosts, but in the external environment-commonly on pasture. It is in this environment that the free-living stages are vulnerable to a range of abiotic factors (extremes in temperature and desiccation) and biotic factors (macro- and micro-organisms) that may decimate their numbers. Of the latter, there are organisms, which exert their effects either indirectly by rendering faecal deposits inimical for the development of nematode eggs through to infective larvae, or directly by acting as pathogens or by exploiting the free-living stages as a food source. Within this vast assemblage of organisms, which include microarthropods, protozoa, viruses, bacteria and fungi, could well emerge a variety of biological control agents of nematode parasites. At present, greatest interest lies with the nematode-destroying fungi. Work has progressed from Petri dishes, to plots, to paddocks with several species of the genus Arthrobotrys and Duddingtonia flagrans. These studies indicate that the voracious nematophagous capabilities of these fungi, clearly demonstrated in vitro, translate to reductions in the number of infective larvae on pasture and indicate that levels of control, comparable to conventional schemes using anthelmintics, can be achieved. The challenge now lies in developing methods of administration of fungi to animals which can be applied under practical farm conditions. However, the pursuit of candidates for biological control of nematode parasites of livestock should not involve just a few species of nematophagous fungi. More than 100 species of fungi have been identified as possessing nematode destroying capabilities. These need to be more specifically investigated for their effects on free-living stages of nematode parasites of livestock, together with other classes of organisms, particularly bacteria, which have proved successful as biological control agents of arthropods.

Walls I. et al. *Use of predictive microbiology in microbial food safety risk assessment.* Int J Food Microbiol. 1997; 36(2-3) : 97-102.p Abstract: Microbial risk assessment is a newly emerging discipline in the area of food safety. One of the difficulties associated with microbial risk assessment is in determining the number of microorganisms in food at a given time, i.e.. estimating exposure of an individual to the microorganism. Numbers of bacteria in food can change at all stages of food production and processing, depending on the nature of the food and the way it is handled, stored and processed. Predictive microbiology can be used to estimate changes in bacterial numbers, allowing exposure of an individual to a pathogen to be assessed. A survey was sent to scientists in the food industry to determine their perspective on the role of predictive microbiology in conducting microbial risk assessments. In this paper, responses to that survey are presented, as well as examples of the potential risk of foodborne illness from a cooked meat product contaminated with Staphylococcus aureus and hamburger contaminated with Salmonella.

Wang R.F. et al. *A universal protocol for PCR detection of 13 species of foodborne pathogens in foods.* J Appl Microbiol. 1997; 83(6) : 727-36.p Abstract: A universal protocol for PCR detection of 13 species of foodborne pathogens in foods was developed. The protocol used a universal culture medium and the same PCR conditions with 13 sets of specific primers. The 13 species of foodborne pathogens examined were Escherichia coli, E. coli-ETEC, E. coli-O157:H7, Shigella spp., Salmonella spp., Yersinia enterocolitica, Y. pseudotuberculosis, Vibrio cholerae, V. parahaemolyticus, V. vulnificus, Listeria monocytogenes, Staphylococcus aureus and Bacillus cereus. No interference was observed using the PCR assay when food sample was artificially inoculated with each individual bacterial species. Twelve different seafood samples and two soft cheese samples without artificial inoculation were

examined by this protocol. Vibrio vulnificus, Salmonella spp., E. coli, Listeria monocytogenes and Bacillus cereus were detected in some foods. Internal probe hybridization and nested PCR procedures were used to confirm the above findings.

Warner C.R. et al. *Determination of free and reversibly bound sulphite in foods by reverse-phase, ion-pairing high-performance liquid chromatography.* Food Addit Contam. 1990; 7(5) : 575-81.p Abstract: The reaction of sulphite with formaldehyde to form hydroxymethylsulphonate (HMS), which is very stable under the controlled conditions of this assay, was used as the first step in an analytical procedure to determine foodborne sulphite. The effect of mobile-phase pH on the stability of HMS during high-performance liquid chromatography was studied. It was found that on-column HMS dissociation to formaldehyde and bisulphite increased with the pH of the mobile phase; therefore the relatively low pH 4.7, at which the dissociation of HMS was approximately 2%, was selected for the analysis. In addition, the release of sulphite from its reversibly bound forms in wine and other foods was examined as a function of the pH of the extraction medium by following the appearance of HMS formed from the reaction of the freed sulphite with formaldehyde. The rate of dissociation of the reversibly bound sulphite was relatively slow at pH 3 but very rapid at pH 7. This difference in kinetics was exploited to develop a procedure to determine free and reversibly bound sulphite in food. The method was challenged by post-reagent spiking studies, i.e. adding the sulphite spike after the food has been blended with the sulphite-protective formaldehyde solution but before proceeding with the remainder of the assay. An average recovery of 100% with a standard deviation of 5.2% (n = 45) was realized at levels of 5, 10 and 20 ppm by weight as sulphur dioxide. Recovery of the sulphite added as the bisulphite addition product of acetaldehyde, a model compound for reversibly bound sulphite, was 95%.

Weagant S.D. et al. *Development of digoxigenin-labeled PCR amplicon probes for use in the detection and identification of enteropathogenic Yersinia and Shiga toxin-producing Escherichia coli from foods.* J Food Prot. 1999; 62(5) : 438-43.p Abstract: By including digoxigenin-11-dUTP in a polymerase chain reaction (PCR), amplification products were produced that contained nonisotopic markers for use as DNA hybridization probes. Because these labeled amplicons encode pathogenic traits for specific foodborne bacteria, they can be used to detect the presence of potentially virulent organisms that may be present in foods. This technology allows the synthesis of a variety of shelf-stable probe reagents for detecting a number of foodborne microbes of public health concern. We used this technology to detect four genes in two potential pathogens: virF and yadA in enteropathogenic Yersinia and stx1 and stx2 in Shiga-like toxin-producing Escherichia coli. Results of DNA hybridizations of dot blots of 68 Yersinia strains and 24 of 25 E. coli strains were consistent with results of equivalent PCR analyses. DNA colony hybridization with nonisotopic virF probes of colonies arising on spread plates from artificially contaminated food homogenates was able to detect potentially pathogenic Y. enterocolitica. When compared with oligonucleotide probes, amplicon probes are much less sensitive to changes in hybridization and wash temperatures, allowing greater reproducibility. Labeled probe preparations were reused more than five times and have been stored at -20 degrees C for more than 8 months. This method conveniently generates probes that are safe, stable, inexpensive, reusable, and reliable.

Weber J.T. et al. *Cholera in the United States, 1965-1991. Risks at home and abroad.* Arch Intern Med. 1994; 154(5) : 551-6.p Abstract: OBJECTIVE: To assess risks for cholera in the United States. DESIGN: Review of published reports of cholera outbreaks and sporadic cases and Centers for Disease Control and Prevention (CDC) memoranda and laboratory reports. PATIENTS: Persons with symptomatic laboratory-diagnosed cholera treated in the United States and territories. RESULTS: From 1965 through 1991, 136 cases of cholera were reported. Fifty-three percent of the patients were hospitalized and three persons died (case-fatality rate, 0.02). Ninety-three infections were acquired in the United States and 42 overseas; for one case the source was unknown. Domestically acquired cholera was largely related to the endemic Gulf Coast focus of Vibrio cholerae 01 (56 cases). The major domestic food vehicle was shellfish, particularly crabs harvested from the Gulf of Mexico or nearby estuaries. In 1991, 14 (54%) of 26 domestically acquired cases were caused by food from Ecuador (n = 11) and Thailand (n = 3). During 1991, the first cases of cholera in travelers returning from South America were reported. In 1991, the rate of cholera among air travelers returning from South America was estimated as 0.3 per 100,000; among air travelers returning from Ecuador, 2.6 per 100,000. CONCLUSIONS: Cholera remains a small but persistent risk in the United States and for travelers. An endemic focus on the Gulf Coast, the continuing global pandemic, and the epidemic in South America make this likely to continue for years to come. Physicians should know how to diagnose and treat cholera and should report all suspected cases to their state health departments.

Weber J.T. et al. *Epidemic cholera in Ecuador: multidrug-resistance and transmission by water and seafood.* Epidemiol Infect. 1994; 112(1) : 1-11.p Abstract: To determine risk factors for cholera in an epidemic-disease area in South America, a case-control investigation was performed in Guayaquil, Ecuador, in July 1991. Residents > 5 years old who were hospitalized for treatment of acute, watery diarrhoea and two matched controls for each were interviewed regarding sources of water and food, and eating, drinking, and hygienic habits. Interviewers inspected homes of case-patients and controls to document water treatment, food-handling, and hygienic practices. Faecal specimens and shellfish were cultured for Vibrio cholerae O 1. Isolates were tested for susceptibility to a variety of antimicrobial agents. Drinking unboiled water (odds ratio [OR] = 4.0, confidence interval [CI] = 1.8-7.5),

drinking a beverage from a street vendor (OR = 2.8, CI = 1.3-5.9), eating raw seafood (OR = 3.4, CI = 1.4-11.5), and eating cooked crab (OR = 5.1, CI = 1.4-19.2) were associated with illness. Always boiling drinking water at home (OR = 0.5, CI = 0.2-0.9) was protective against illness. The presence of soap in either the kitchen (OR = 0.3, CI = 0.2-0.8) or bathroom (OR = 0.4, CI = 0.2-0.9) at home was also protective. V. cholerae O 1 was recovered from a pooled sample of a bivalve mollusc and from 68% of stool samples from case-patients. Thirty-six percent of the isolates from stool specimens were resistant to multiple antimicrobial agents. Specific prevention measures may prevent transmission through these vehicles in the future. The appearance of antimicrobial resistance suggests the need for changes in current methods of prevention and treatment.

Weinstein J. *The clean restaurant. II: Employee hygiene.* Restaurants Inst. 1991; 101(13) : 138-9, 142, 144 passim.p Abstract: Poor personal hygiene causes more than 90% of the sanitation problems in the foodservice industry. Government statistics show improper hand washing alone accounts for more than 25% of all foodborne illnesses. In Part II of R&I's sanitation series, experts describe in detail proper procedures for reducing cross-contamination in the workplace and suggest ways to deal with a new problem--style vs. safety, including what apparel, jewelry, cosmetics and hair styles can and cannot be worn on the job.

White P.L. et al. *Strategies to control Salmonella and Campylobacter in raw poultry products.* Rev Sci Tech. 1997; 16(2) : 525-41.p Abstract: Foodborne illness is a major public health concern. The largest number of foodborne illness cases attributed to poultry and poultry products are caused by paratyphoid serotypes of Salmonella and by Campylobacter jejuni. The effective prevention of foodborne disease requires an understanding that contamination can be introduced into foods at numerous points along the food chain. Since multiple entry points exist for foodborne pathogens, multifaceted intervention approaches are required to successfully control contamination of poultry during the various phases of the growth period and processing procedure of broiler chickens. Strategies during the grow-out period (the period during which day-old chicks are raised to six- to seven-week-old broiler chickens) include sanitation, biosecurity, vaccine and drug therapy, and biological control procedures, such as those aimed at preventing colonisation. There are also many critical control points identified in the processing plant which reduce contamination. These include temperature controls (washer and product), chemical interventions, water replacements and counter-flow technology in the scalder and chiller, and equipment maintenance. Transportation and food handling at retail outlets and by the consumer (i.e., storage at the proper temperature and adequate cooking) are the final critical control points in the farm-to-table continuum. It is important to apply risk reduction strategies throughout the food chain. These include: easing the development and implementation of voluntary animal production 'best management practices', implementing in-plant hazard analysis and critical control point systems, developing effective transportation and refrigeration standards, working to facilitate adoption of the model Food Code in all States and providing educational materials and support for public health activities nationwide.

Wilkinson P.J. et al. *Cook-chill, cook-freeze, cook-hold, sous vide: risks for hospital patients?* J Hosp Infect. 1991; 18 Suppl A : 222-9.p Abstract: Changes in eating habits and developments in food technology are occurring at the same time as an upward trend in foodborne infection in Britain. Vulnerable people such as the elderly and hospital patients are increasingly likely to consume food produced by new systems such as 'cook-chill' and 'cuisson sous vide'. The microbiological hazards of these systems are assessed as negligible, provided that production is controlled by appropriate methods such as the hazard analysis critical control point (HACCP) approach. The occurrence and control of bacterial contamination in a hospital cook-chill system is reviewed in this context.

Wilkinson T.H. et al. *Salmonella outbreaks in the Kansas City metropolitan area: varying presentations.* Mo Med. 1999; 96(2) : 62-6.p Abstract: Four outbreaks of Salmonella in the Kansas City metropolitan area between 1996 and 1998 are used to illustrate changes in the epidemiology of foodborne diseases and recognition by public health authorities. Physicians are the critical link in the recognition of foodborne outbreaks, and that linkage is tied directly to their index of suspicion and the appropriate collection and testing of specimens from their patients, as well as notification of the local health department.

Wittman R.J. et al. *Microbial contamination of shellfish: prevalence, risk to human health, and control strategies.* Annu Rev Public Health. 1995; 16 : 123-40.p Abstract: There has been significant concern in recent times about the safety of molluscan shellfish for human consumption. Despite extensive efforts to assure a safe supply of molluscan shellfish, the number of cases of disease and death are still great enough to cause concern among the public. The number of cases of illness and death associated with the ingestion of shellfish falls in the lower end of the range of other similar microbial pathogen-related foodborne disease. Disease and deaths due to viruses and naturally occurring bacteria are now of greatest concern because they are the most often cited causative agents. The greatest risk of disease or death due to shellfish consumption is among the population with underlying health conditions who choose to consume raw shellfish. Control strategies to limit shellfish-borne disease should focus upon disease and death caused by viruses and naturally occurring bacteria among at-risk populations.

Wong A.C. *Biofilms in food processing environments.* J Dairy Sci. 1998; 81(10) : 2765-70.p Abstract: Biofilms are a constant concern in food processing environments. Our

overall research focus has been to understand the interaction of factors affecting bacterial attachment and biofilm formation with the ultimate goal of devising strategies to control this problem. This paper briefly describes three areas of biofilm research in which we have been involved. Listeria monocytogenes, a foodborne pathogen, survived for prolonged periods on stainless steel and buna-n rubber, materials commonly used in food-processing equipment. Survival was affected by temperature, relative humidity, attachment surface, and soil. Some components in the rubber inhibited growth of the organism on buna-n, which also affected the efficacy of sanitizers on biofilm inactivation. In cheese manufacture, biofilms of Lactobacillus curvatus could lead to a defect caused by the formation of calcium lactate crystals in Cheddar cheese. This hardy organism persisted in low numbers on equipment surfaces and was difficult to eradicate. We investigated the relative contributions and interactions of mechanical, thermal, and chemical processes in an air-injected clean-in-place method for milking systems. Overall, it is important to study the interactions between bacteria and the surfaces in a specific food processing environment to provide more effective measures for prevention of biofilm formation and for its removal.

Wong H.C. et al. *Characterization of Vibrio parahaemolyticus isolates obtained from foodborne illness outbreaks during 1992 through 1995 in Taiwan.* J Food Prot. 2000; 63(7) : 900-6.p Abstract: Vibrio parahaemolyticus is an important foodborne pathogen in Taiwan and many other Asian countries. A total of 371 isolates of V. parahaemolyticus collected from patients involved in foodborne illness outbreaks in Taiwan from 1992 to 1995 were characterized. These isolates had typical biochemical characteristics and only 4% were urease positive. The most frequently isolated serovars were O5:K15 (18.5%), O4:K8 (16.2%), O3:K29 (12.5%), O1:K56 (8.3%), O2:K3 (6.5%), and O4:K12 (6.0%). Most of the isolates were susceptible to nalidixic acid, tetracycline, tobramycin, cephalothin, and gentamicin. About 10% of the isolates were resistant to seven or more antibiotics. Approximately 92.4% of these V. parahaemolyticus showed beta-hemolysis on Wagatsuma blood agar plate and approximately 62.1% of these isolates exhibited detectable amounts of thermostable direct hemolysin. Most of the isolates examined exhibited two copies of tdh genes on the 1.3- and 2.5-kb HindIII-digested chromosome fragments with several variations on other fragments. A pulsed-field gel electrophoresis (PFGE) subspecies typing scheme was used to analyze these domestic isolates and the O3:K6 strains from Japan, Korea, and Taiwan. Fifty seven patterns were differentiated with A, B, C, E, and H being the major domestic types (cumulatively 76% of isolates), while O3:K6 strains (PFGE type I), abruptly occurring since 1996, were genetically distant from the major domestic types.

Wood O.B. et al. *Position of the American Dietetic Association: food irradiation.* J Am Diet Assoc. 2000; 100(2) : 246-53.p Abstract: Food irradiation has been identified a sa safe technology to reduce the risk of foodborne illness as part of high-quality food production, processing, handling, and preparation. Food irradiation's history of scientific research , evaluation, and testing spans more than 40 countries around the world and it has been endorsed or support by numerous national and international food and organizations and professional groups. Food irradiation utilizes a source of ionizing energy that passes through food to destroy harmful bacteria and other organism. Often referred to as "cold pasteurization," food irradiation offers negligible loss of nutrients or sensory qualities in food as it does not substantially raise the temperature of the food during processing. Food irradiation does not replace proper food production, processing, handling, or preparation, nor can it enhance the quality of or prevent contact with foodborne bacteria after irradiation. In the United States, manufacturers are required to identify irradiated food sold to consumers with an international symbol (Radura) and and terminology describing the process on product labels. In addiction, food irradiation facilities are thoroughly regulated and monitored for worker and environmental safety. Members of The American Dietetic Association (ADA) and other food, nutrition, and health professionals have a responsibility to educate consumers, food processors, manufacturers and retailers about the safety and application of the technology. When consumers are educated about food irradiation, many prefer irradiated products because of their increased safety. It is the position of ADA that food irradiation enhances the safety and quality of the food supply and helps protect consumers from foodborne illness. The ADA encourages the government, food manufactures, food commodity groups, and qualified food and nutrition professionals to work together to educate consumers about this additional food safety tool and make this choice available in the marketplace.

Y

Yagupsky P. et al. *Use of multiple markers for investigation of an epidemic of Shigella sonnei infections in Monroe County, New York.* J Clin Microbiol. 1991; 29(12) : 2850-5.p Abstract: Antibiotic susceptibility patterns, plasmid profiles, and endonuclease restriction analysis of plasmid DNA were used in the investigation of an epidemic of Shigella sonnei infections in Monroe County, New York, in 1988 and 1989. The epidemic peaked during the winter, included the simultaneous transmission of the disease from person to person and from common food sources, and especially affected inhabitants of the poor, inner-city neighborhoods, young children of both sexes, and women. Resistance to ampicillin, tetracycline, or trimethoprim-sulfamethoxazole, encoded in a 70-MDa plasmid, was found in most of the examined isolates. Unexpectedly, isolates from patients involved in a food-borne outbreak exhibited three different antibiotic susceptibility patterns, suggesting deletion of antibiotic resistance determinants in some strains. Antibiograms clearly separated food-borne outbreak-related and non-foodborne outbreak-related strains, distinguished more strains than did the plasmid profiles, and were useful in tracing the dissemination of

individual isolates in the community. Restriction endonuclease analysis substantially increased the discriminatory value of plasmid profiles and validated the antibiogram results. The present study illustrates the complexity of epidemics of S. sonnei infections and shows the value of combining different biological markers in the investigation.

Yang S. et al. *Evaluation of safe food-handling instructions on raw meat and poultry products.* J Food Prot. 2000; 63(10) : 1321-5.p Abstract: Every year in the United States, millions of people become ill, thousands of people die, and substantial economic costs are incurred from foodborne diseases. As a measure to prevent foodborne diseases, since July 1994, the U.S. Department of Agriculture has required that safe food-handling labels be placed on retail packages of raw or partially cooked meat and poultry products. Through selected states' Behavioral Risk Factor Surveillance System (BRFSS) interviews, survey data were collected to determine the proportion of adults aware of the label and adults who reported changing their raw meat-handling practices because of the label. Fifty-one percent of the 14,262 respondents reported that they had seen the label. Of these, 79% remembered reading the label, and 37% of persons who reported that they had seen and read the label reported changing their raw meat preparation methods because of the label. Women were more likely than men to have read the label, as were persons who are at least 30 years of age compared to younger adults ($P < 0.05$). Both label awareness and risky food-handling behaviors increased with education and income, suggesting that safe food-handling labels have limited influence on consumer practices. Our results also suggest that the labels might be more effective in discouraging cross-contamination than in promoting thorough cooking practices. We suggest that the label is only one component among many food safety education programs that are needed to inform consumers about proper food-handling and preparation practices and to motivate persons who have risky food-handling and preparation behaviors to change these behaviors.

Yang S. et al. *Multistate surveillance for food-handling, preparation, and consumption behaviors associated with foodborne diseases: 1995 and 1996 BRFSS food-safety questions.* Mor Mortal Wkly Rep CDC Surveill Summ. 1998; 47(4) : 33-57.p Abstract: PROBLEM/CONDITION: In 1995, CDC, the Food and Drug Administration (FDA), and several state health departments collaboratively developed questions regarding food safety. This set of questions was used to collect data about food-handling, preparation, and consumption behaviors that have been associated with foodborne diseases in adults. These data will help characterize persons at high risk for foodborne illness and assist in developing food-safety education strategies for consumers and foodhandlers that are intended to reduce foodborne illness. REPORTING PERIOD COVERED: January 1995-December 1996. DESCRIPTION OF SYSTEM: Data were collected by using the 12 food-safety questions, which were administered with the 1995 Behavioral Risk Factor Surveillance Systems (BRFSS) in Colorado, Florida, Missouri, New York, and Tennessee, and the 1996 BRFSS in Indiana and New Jersey. In addition, data were collected in South Dakota from two of the standardized questions that deal with consumption of undercooked eggs and pink hamburgers. The BRFSS is a state-based system that surveys noninstitutionalized adults by telephone about their health behaviors and practices. RESULTS: This study included 19,356 completed questionnaires (2,461 in Colorado; 3,335 in Florida; 2,212 in Indiana; 1,572 in Missouri; 3,149 in New Jersey; 2,477 in New York; 2,110 in South Dakota; and 2,040 in Tennessee). During the previous 12 months, 50.2% of respondents reported eating undercooked eggs (95% confidence interval [CI] = 49.2-51.2); 23.8% reported eating home-canned vegetables (95% CI = 22.5-24.5); 19.7% reported eating pink hamburgers (95% CI = 18.9-20.5); 8.0% reported eating raw oysters (95% CI = 7.5-8.5); and 1.4% reported drinking raw milk (95% CI = 1.2-1.6). The prevalence of not washing hands with soap after handling raw meat or chicken and not washing a cutting board with soap or bleach after using it for cutting raw meat or chicken were 18.6% (95% CI = 17.8-19.4) and 19.5% (95% CI = 18.6-20.4), respectively. Less than half of respondents (45.4%, 95% CI = 44.2-46.6) reported seeing safe food-handling label information on raw meat products. In addition, among those persons who reported they remembered seeing the label information, 77.2% (95% CI = 76.0-78.4) remembered reading the label information, and 36.7% reported changing their meat and poultry preparation habits because of the labels (95% CI = 35.2-38.2). When population characteristics were considered in the analysis, all high-risk food-handling, preparation, and consumption behaviors were more prevalent in men than in women. Eating pink hamburgers during the previous 12 months was more commonly reported by whites (22.3%) than by blacks (6.5%). The prevalence of reported consumption of pink hamburgers during the previous. 12 months decreased with age (18-29 years: 21.8%, 30-59 years: 21.9%, and 60-99 years: 13.2%); increased with education (less than grade 12: 12.0%, high school graduate: 16.5%, and any college education: 24.0%); and increased with income (< $15,000: 11.8%, $15,000-$34,999: 17.6%, $35,000-$49,999: 22.0%, and > or = $50,000: 28.6%). INTERPRETATION: During 1995-1996, several high-risk food-handling, preparation, and consumption behaviors were common, and some were particular to specific population groups. Based on this analysis, interventions are needed to reduce the prevalence of these risky behaviors. All consumers and foodhandlers could benefit from food-safety education. ACTIONS TAKEN: Behavioral surveillance systems can provide data that identify persons or groups in which behaviors associated with foodborne diseases are more common and who are at higher risk for foodborne illness. State-specific data can assist in developing food-safety education programs and, if collected periodically, can be used to evaluate program effectiveness.

Ying J. *Chinese-style barbecued meats: a public health challenge.* Can J Public Health. 2000; 91(5) : 386-9.p

Abstract: The custom of displaying Chinese-style barbecued meats at room temperature has been a controversial food safety issue in North America. This article is intended to facilitate development of a risk-based food safety policy for this unique food by providing a brief overview of the recent study findings and Canadian disease surveillance data. Despite the lack of temperature control after cooking, Chinese barbecued meats were rarely implicated in foodborne incidents in Canada between 1975 and 1993. This might be due to the food's ability to delay pathogen growth during the first 5 hours immediately after cooking, and the conventional trade practices of separating the retail area from the main kitchen (i.e., reducing risk of cross-contamination). However, recent studies also pointed out the high potential for cross-contamination during the retail stage (i.e., chopping and packaging the food) as a result of lack of proper hand-washing and equipment sanitation. A risk-based food safety policy is proposed.

Z

Zaika L.L. et al. *Revised model for aerobic growth of Shigella flexneri to extend the validity of predictions at temperatures between 10 and 19 degrees C.* Int J Food Microbiol. 1998; 41(1) : 9-19.p Abstract: Although Shigella is a major foodborne pathogen, its growth in foods has received little attention. Growth of S. flexneri 5348 inoculated into commercially available sterile foods (canned broths, meat, fish, UHT milk, baby foods) was studied at 10 to 37 degrees C. S. flexneri was enumerated by surface-plating on Tryptic Soy Agar and growth curves were fitted by means of the Gompertz equation. Observed growth kinetics values and values calculated using a previously developed response surface model compared favorably for growth at 19 to 37 degrees C, but not at < 19 degrees C. To refine the model, additional data were collected for growth at 10 to 19 degrees C. A total of 844 tests in BHI broth, representing 197 variable combinations of temperature (10-37 degrees C), pH (5.0-7.5), NaCl (0.5-5.0%) and NaNO2 (0-1000 ppm) was used for the revised model. The revised model, developed in BHI, gave significantly better agreement of calculated growth kinetics values with those observed in foods at 10 to 19 degrees C.

Zaika L.L. et al. *Growth of Shigella flexneri in foods: comparison of observed and predicted growth kinetics parameters.* Int J Food Microbiol. 1996; 32(1-2) : 91-102.p Abstract: Shigella causes foodborne gastrointestinal illness; however, little information is available on its ability to grow in foods. Commercially available sterile foods (UHT milk, beef broth, chicken broth, vegetable broth, meats, vegetables) were inoculated with S. flexneri 5348 and incubated at 12, 15, 19, 28 or 37 degrees C. Growth curves were fitted from plate count data by the Gompertz equation and exponential growth rates, generation times, lag times and maximum population densities were derived. The observed kinetics values, expressed as T1000 (time, h, required for a 3 log increase in bacterial population), were compared with values calculated using published growth models. Observed and calculated values compared favorably for growth at 19-37 degrees C. S. flexneri grew well in milk at 15-37 degrees C but growth at 12 degrees C was variable. The bacteria readily grew in most foods, even at 12 degrees C; but died off in carrots at 19 and 28 degrees C. Factors other than those used in the growth model may influence bacterial growth in specific foods.

Zwieterin M.H. et al. *Sensitivity analysis in quantitative microbial risk assessment.* Int J Food Microbiol. 2000; 58(3) : 213-21.p Abstract: The occurrence of foodborne disease remains a widespread problem in both the developing and the developed world. A systematic and quantitative evaluation of food safety is important to control the risk of foodborne diseases. World-wide, many initiatives are being taken to develop quantitative risk analysis. However, the quantitative evaluation of food safety in all its aspects is very complex, especially since in many cases specific parameter values are not available. Often many variables have large statistical variability while the quantitative effect of various phenomena is unknown. Therefore, sensitivity analysis can be a useful tool to determine the main risk-determining phenomena, as well as the aspects that mainly determine the inaccuracy in the risk estimate. This paper presents three stages of sensitivity analysis. First, deterministic analysis selects the most relevant determinants for risk. Overlooking of exceptional, but relevant cases is prevented by a second, worst-case analysis. This analysis finds relevant process steps in worst-case situations, and shows the relevance of variations of factors for risk. The third, stochastic analysis, studies the effects of variations of factors for the variability of risk estimates. Care must be taken that the assumptions made as well as the results are clearly communicated. Stochastic risk estimates are, like deterministic ones, just as good (or bad) as the available data, and the stochastic analysis must not be used to mask lack of information. Sensitivity analysis is a valuable tool in quantitative risk assessment by determining critical aspects and effects of variations.

ANNEX 1

Classification of Food-borne Diseases By Symptom, Incubation Period, and Type of Agent

Classification of Food-borne Diseases by Symptom, Incubation Period, and Type of Agent

Disease	Etiologic agent or source	Incubation period (latency)	Sign and Symptoms	Food implicated[3]	Specimen to be obtained	Contributing factors
1. Initial or major signs and symptoms of the upper digestive tract (nausea, vomiting) 1.1 Incubation period tends to be less than one hour						
			Fungal agents			
Poisoning by mushrooms of the group that causes gastrointestinal irritation	Possibly resin-type substances found in some types of mushrooms	From 30 minutes to 2 hours	Nausea, vomiting, retching, diarrhea, abdominal pains	Many varieties of wild mushrooms	Vomit	Ingestion of unknown toxic varieties of mushrooms that have been confused with edible varieties
			Chemical agents			
Antimony poisoning	Antimony found in enamelware	From a few minutes to 1 hour	Vomiting, abdominal pains, diarrhea	Very acid foods and beverages	Vomit, stool, urine	
Cadmium poisoning	Cadmium found in plated utensils	From 15 to 30 minutes	Nausea, vomiting, abdominal pains, diarrhea, shock	Very acid foods and beverages, candies, and other cake decorations	Vomit, stool, urine, blood	Use of utensils that contain cadmium, storage of very acid food in recipients that contain cadmium, ingestion of foods that contain cadmium
Copper	Copper found in	From a few	Metallic taste,	Very acid foods	Vomit, gastric	Storage of very acid foods in

poisoning	pipes and utensils	minutes to a few hours	nausea, vomiting (green vomit), abdominal pains, diarrhea	and beverages	lavage, urine, blood	copper containers or use of copper piping to serve very acid beverages, defective valves in devices to prevent reflux (in dispensers)
Fluoride poisoning (fluorosis)	Sodium fluoride found in insecticides	From a few minutes to 2 hours	Salty or soapy taste, numbness in the mouth, vomiting, diarrhea, abdominal pains, pallor, cyanosis, dilated pupils, spasms, collapse, shock	Any food contaminated accidentally, in particular dry foods, such as powdered milk, flour, baking powder, and cake mixes	Vomit, gastric washing	Storage of insecticides in the same place as food, confusing pesticides with powdered foods
Lead poisoning	Lead contained in earthenware pots, pesticides, paints, plaster, putty	30 minutes or more	Metallic taste, burning in the mouth, abdominal pains, milky vomit, black stool or presence of blood, bad breath, shock, blue line at the edge of the gums (“lead line”)	Very acid foods and beverages stored in recipients that contain lead, any food contaminated accidentally	Vomit, gastric washing, stool, blood, urine	Use of recipients that contain lead, storage of very acid foods in recipients that contain lead, storage of pesticides in the same place as foods
Tin poisoning	Tin found in tin cans	From 30 minutes to 2 hours	Swelling, nausea, vomiting, abdominal pains,	Very acid foods and beverages	Vomit, stool, urine, blood	Storage of acid foods in unlined tin containers

			diarrhea, headache			
Zinc poisoning	Zinc found in galvanized containers	From a few minutes to 2 hours	Pains in the mouth and abdomen, nausea, vomiting, dizziness	Very acid foods and beverages	Vomit, gastric washing, urine, blood, stool	Storage of very acid foods in galvanized cans

1.2 Incubation period of 1 to 6 hours

Bacterial agents

Staphylococcal food poisoning	Exoenterotoxins A, B, C, D, and E of *Staphylo-coccus aureus*. Staphylococci from the nose, skin, and lesions of infected people and animals, and infected cow udders	From 1 to 8 hours (average of 2 to 4 hours)	Nausea, vomiting, retching, abdominal pains, diarrhea, prostration	Ham, beef, or poultry products, cream-filled pastries, food mixes, leftover foods	From the patient: vomit, stool, rectal swabs. From carriers: nasal swabs, swabs from lesion, and rectal swabs	Inadequate refrigeration, handler touched cooked food, preparation of food several hours before serving, handlers with purulent infections, food kept at warm temperatures (bacterial incubation), fermentation of food abnormally low in acids

Chemical agents [4]

Nitrate poisoning	Nitrites or nitrates used in	From 1 to 2 hours	Nausea, vomiting, cyanosis,	Cured meats, any food	Blood	Use of excessive quantities of nitrites or nitrates to cure food or

curing meat, or water from shallow wells	headache, dizziness, weakness, loss of consciousness, chocolate-colored blood	contaminated accidentally, from exposure to excessive nitrification	conceal spoilage, confusion of nitrites with table salt or other condiments, inadequate refrigeration

1.3 Incubation period usually from 7 to 12 hours

Fungal agents

Poisoning caused by mushrooms of the cyclopeptide and *Giromitra* groups	Cyclopeptides and gyromitrine found in certain mushrooms	From 6 to 24 hours	Abdominal pains, feeling of fullness, vomiting, prolonged diarrhea, loss of strength, thirst, muscle cramps, rapid and weak pulse, collapse, jaundice, somnolence, dilated pupils, coma, death	*Amanita phalloides, A. Verna, Galerina autumnalis, Giromitra esculenta,* and similar species of mushrooms	Urine, blood, vomit	Ingestion of certain species of *Amanita, Galerina,* and *Giromitra* mushrooms, ingestion of unknown varieties of mushrooms, confusion of poisonous mushrooms with edible varieties

2. Manifestation of pharyngitis and respiratory signs and symptoms

2.1 Incubation period less than 1 hour

Chemical agents

Sodium hydroxide poisoning	Sodium hydroxide (caustic soda) found in compounds used to wash bottles,	A few minutes	Burning of the lips, mouth, and throat; vomiting, abdominal pains, diarrhea	Bottled beverages	Vomit	Improper rising of bottles that have been washed with a caustic substance

	detergents, drain cleansers, hair relaxants					

2.2 Incubation period from 12 to 72 hours

Bacterial agents

Infections caused by beta-hemolytic streptococci	*Streptococcus pyogenes* from the throat and lesions of infected persons	From 1 to 3 days	Pharyngitis, fever, nausea, vomiting, rhinorrhea, sometimes rash	Raw milk, foods containing egg	Pharyngeal swabs, vomit	Handlers who touched cooked food, handlers with purulent infections, inadequate refrigeration, improper cooking or reheating, preparation of food several hours before serving

3. Initial or major signs and symptoms of the lower digestive tract (abdominal pains, diarrhea)

3.1 Incubation period usually from 7 to 12 hours

Bacterial agents

Gastroenteritis caused by *Bacillus cereus*	Exoenterotoxin of *B.cereus*; agent found in soil	From 8 to 16 hours; rarely from 2 to 4 hours	Nausea, abdominal pains, diarrhea; sometimes vomiting	Foods made from grains, rice, custard, sauces, and meatballs	Stool, vomit	Inadequate refrigeration, storage of food at warm temperatures (bacterial incubation), preparation of food several hours before serving, improper reheating of leftovers
Gastroenteritis caused by *Clostridium*	Endoenterotoxin formed during sporulation of *C.*	From 8 to 22 hours (average of 10	Abdominal pains, diarrhea	Cooked beef or poultry, bouillons,	Stool	Inadequate refrigeration, storage of food at warm temperatures (bacterial incubation),

perfringens	*perfringens* in the intestines; agent found in human or animal feces and in the soil	hours)	sauces, and soups	preparation of food several hours before serving, improper reheating of leftovers

3.2 Incubation period usually from 12 to 72 hours

Bacterial agents

Cholera	Endoenterotoxin of *Vibrio cholerae*, classical and El Tor biotypes, from feces of infected persons	From 1 to 3 days	Severe, watery diarrhea (rice-water stools), vomiting, abdominal pains, dehydration, thirst, collapse, loss of skin tone, shriveled fingers, sunken eyes	Raw fish and shellfish, food washed or prepared with contaminated water, water	Stool	Harvesting of fish of shellfish from water contaminated with sewage in endemic areas, poor personal hygiene, infected handlers who touch the food, inadequate cooking, use of contaminated water to wash or rinse food, improper waste-water disposal, use of waste from latrines as fertilizer
Gastroenteritis caused by pathogenic *Escherichia coli*	Enterotoxigenic or invasive strains of *E. Coli* from feces of infected people and animals	From 5 to 48 hours (average of 10 to 24 hours)	Abdominal pains, diarrhea, nausea, vomiting, fever, chills, headache, myalgia	Various foods, water	Stool, rectal swabs	Infected handlers who touch the food, inadequate refrigeration, improper cooking, improper cleaning and disinfection of equipment
Salmonellosis	Various serotypes of *Salmonella* from feces of infected people and animals	From 6 to 72 hours (average of 18 to 36 hours)	Abdominal pains, diarrhea, chills, fever, nausea, vomiting, malaise	Beef and poultry meat and products, egg products, other food contaminated with salmonellae	Stool, rectal swabs	Inadequate refrigeration, storage of food at warm temperatures (bacterial incubation), improper cooking and reheating, preparation of food several hours before serving, cross-contamination, improper cleaning of equipment, infected handlers who touch cooked food,

						acquisition of food from contaminated sources
Shigellosis	*Shigella flexneri, S. dysenteriae, S. sonnei* and *S. boydii* from feces of infected people	From 24 to 72 hours	Abdominal pains, diarrhea, mucoid feces with blood present, fever	Any contaminated food (often salads), water	Stool, rectal swabs	Infected handlers who touch the food, inadequate refrigeration improper cooking and reheating
Gastroenteritis caused by *Vibrio parahaemolyticus*	*V. parahaemo-lyticus* from sea water or marine products	From 2 to 48 hours (average of 12 hours)	Abdominal pains, diarrhea, nausea, vomiting, fever, chills, headache	Raw seafood, shellfish	Stool, rectal swabs	Inadequate cooking, improper refrigeration, cross-contamination, improper cleaning of equipment, use of sea water to prepare food

3.3. Incubation period greater than 72 hours

Viral agents

Viral gastroenteritis	Enteric (echovirus, coxasackievirus, reovirus, adenovirus)	From 3 to 5 days	Diarrhea, fever, vomiting, abdominal pains, sometimes respiratory symptoms	Unknown	Stool	Poor personal hygiene, infected workers who touch food, improper cooking and reheating

Parasitic agents

Amebic	*Entamoeba*	From 5 days	Abdominal	Raw fruits and	Stool	Poor personal hygiene, infected

dysentery (amebiasis)	*histolytica* from the feces of infected people	to several months (average of 3 or 4 weeks)	pains, constipation or bloody, mucoid diarrhea	vegetables		handlers who touch the food, improper cooking
Taeniasis due to *Taenia saginata* (beef tapeworm)	*Taenia saginata* from meat of infested cattle	From 3 to 6 months	General malaise, hunger, weight loss, abdominal pains	Raw or undercooked meat	Stool	Failure to inspect meat, improper cooking, improper wastewater disposal, pasture contaminated by wastewater
Diphyllobothri-asis (fish tapeworm infection)	*Diphyllobothrium latum* from meat of infested fish	From 5 to 6 weeks	Undefined gastrointestinal discomfort, anemia possible	Raw of undercooked freshwater fish	Stool	Improper cooking, improper wastewater disposal, lakes contaminated by wastewater
Giardiasis	*Giardia lamblia* from feces of infected people	From 1 to 6 weeks	Abdominal pains, mucoid diarrhea, greasy stools	Raw fruits and vegetables, water	Stool	Poor personal hygiene, infected handlers who touch food, improper cooking, improper wastewater disposal
Taeniasis due to *Taenia solium* (pork tapeworm)	*Taenia solium* from infested pork	From 3 to 6 weeks	General malaise, hunger, weight loss	Raw or undercooked pork	Feces	Failure to inspect meat, improper cooking, improper wastewater disposal, pasture contaminated by wastewater

4. Manifestation of neurological signs and symptoms (visual disorders, tingling, paralysis) [4]

4.1 Incubation period tends to be less than one hour

Fungal agents

Poisoning	Ibotenic acid and	From 30 to	Somnolence and	*Amanita*		Ingestion of *Amanita muscaria*

caused by mushrooms of the group that contains ibotenic acid	muscimol found in certain mushrooms	60 minutes	state of intoxication, confusion, muscle spasms, delirium, visual disorders	*muscaria, A. Pantherina* and related species of mushrooms		and related species of mushrooms, ingestion of varieties of unknown mushrooms, confusion of poisonous mushrooms with edible varieties

4.2 Incubation period from 1 to 6 hours

Chemical agents

Intoxication caused by chlorinated hydrocarbon	Insecticides containing chlorinated hydrocarbon, such as aldrin chlordane, DDT, dieldrin, endrin, lindane, and toxaphene	From 30 minutes to 6 hours	Nausea, vomiting, paresthesia, dizziness, muscular weakness, anorexia, weight loss, confusion	Any food contaminated accidentally	Blood, urine, stool, gastric washing	Storage of insecticides in the same place as foods, confusion of pesticides with powdered food

Poisonous animals

Ciguatera	Ciguatoxin found in the intestines, roe, gonads, and meat of tropical salt-water fish	From 3 to 5 hours, sometimes longer	Tingling and numbness around the mouth, metallic taste, dryness of the mouth, gastrointestinal symptoms,	Numerous varieties of tropical fish		Ingestion of liver, intestines, roe, gonads, or meat of fish from tropical reefs; in general, large reef fish are more likely to be toxic

watery stool,
myalgia,
dizziness, dilated
pupils, blurred
vision,
prostration,
paralysis

Poisonous plants

Jimsonweed (thorn apple) poisoning	Tropane alkaloids, found in *Datura stramonium* (Jimsonweed, thron apple)	Less than 1 hour	Abnormal thrist, photophobia, distorted vision, difficulty speaking, facial flushing, delirium, coma, rapid pulse	Any part of the plant, tomatoes grown from grafts	Urine	Ingestion of any part of the Jimsonweed or tomatoes grown from grafts
Water hemlock poisoning	Resin or cicutoxin found in water hemlock (*Cicuta*)	From 15 to 60 minutes	Excessive salivation, nausea, vomiting, stoma chache, frothing at the mouth, irregular breathing, convulsions, respiratory paralysis	Water hemlock root (*Cicuta virosa* and *C. maculata*)	Urine	Ingestion of water hemlock, confusion of water hemlock root with wild parsnip, sweet potatoes, or carrots

Poisoning caused by mushrooms of the group that contains muscarine (muscarinism)	Muscarine found in certain mushrooms	From 15 minutes to 2 hours	Excessive salivation, perspiration, lacrimation, drop in blood pressure, irregular pulse, contraction of the pupils, blurred vision, asthmatic breathing	*Clitocybe dealbata, C. rivulose* and many species of *Inocybe* and *Boletus* mushrooms	Vomit	Ingestion of mushrooms of the group that contains muscarine, ingestion of unknown varieties of mushrooms, confusion of poisonous mushrooms with edible varieties
			Chemical agents			
Organophos-phorous poisoning	Organophos-phorous insecticides, such as parathion, TEPP, diazinon, malathion	From a few minutes to a few hours	Nausea, vomiting, abdominal pains, diarrhea, headache, nervousness, blurred vision, chest pains, cyanosis, confusion, spasmodic contractions, convulsions	Any food contaminated accidentally	Blood, urine, adipose tissue (for biopsy)	Spraying of crops immediately before harvest, storage of insecticides in the same place as food, confusion of pesticides with powdered foods

Shellfish poisoning	Saxitoxin and similar toxins produced by various species of *Gonyaulax*, a plankton consumed by shellfish	From a few minutes to 30 minutes	Tingling, burning and numbness around the lips and fingertips, dizziness, incoherent speech, respiratory paralysis	Mussels and clams		Harvesting shellfish in areas with high concentrations of *Gonyaulax*
Tetrodotoxism (tetraodon poisoning)	Tetrodotoxin found in the intestines and gonads of puffer fish (blowfish, globefish)	From 10 minutes to 3 hours	Tingling sensation in the fingers and toes, dizziness, pallor, numbness of the mouth and limbs, gastrointestinal symptoms, hemorrhaging desquamation of the skin, fixation of the eyes, spasmodic contraction, paralysis, cyanosis	Fish of the puffer fish family		Ingestion of fish of the puffer fish family, consumption of such fish without removing the intestines and gonads

4.3 Incubation period usually from 12 to 72 hours

Bacterial agents

Botulism	Exoneurotoxins A, B, E, and F of *Clostridium botulinum*. The spores are found in the soil and animal intestines.	From 2 hour to 8 days (average of 18 to 36 hours)	Vertigo, double or blurred vision, dryness of the mouth, difficulty swallowing, speaking, and breathing; descending flaccid paralysis, constipation, dilation or fixation of the pupils, respiratory paralysis. Gastrointestinal symptoms may precede neurological symptoms. Frequently fatal	Home-canned goods that are low in acids, vacuum-packed fish, fermented roe, fish and marine mammals	Blood, stool	Improper preparation of canned foods and smoked fish, uncontrolled fermentation

4.4 Incubation period greater than 72 hours

Chemical agents

Mercury poisoning	Ethel and methyl compounds of mercury in industrial waste and organic mercury in fungicides	1 week or more	Numbness, weakness of the legs, spastic paralysis, deterioration of vision, blindness, coma	Grains treated with fungicides that contain mercury; pork, fish, and seafood exposed to mercury compounds	Urine, blood, hair	Water courses contaminated with mercury compounds, feeding animals with grains treated with fungicides containing mercury, ingestion of mercury, ingestion of grains treated with mercury or meat from animals fed with such grains

Triorthocresyl phosphate poisoning	Triorthocresyl phosphate used as an extract or as a substitute for cooking oil	From 5 to 21 days (average of 10 days)	Gastrointestinal symptoms, pains in the legs, very accentuated equine gait, limpness of feet and wrists	Cooking oils, extracts, and other foodstuffs contaminated with triorthocresyl phosphate		Use of the compound as an extract or as oil for cooking or for salads

5. Manifestation of signs and symptoms of generalized infection (fever, chills, malaise, pains)

5.1 Incubation period greater than 72 hours

Bacterial agents

Brucellosis	*Brucella abortus, B. Melitensis* and *B. Suis* in tissues and milk of infected animals	From 7 to 21 days	Fever, chills, sweats, weakness, malaise, headache, myalgia and arthralgia, weight loss	Raw milk, goat cheese	Blood	Unpasteurized milk, livestock infected by brucellas
Q Fever	*Coxiella burnetii* in tissues and milk of infected animals	From 14 to 26 days (average of 20 days)	Chills, headache, malaise, weakness, perspiration, fever, couch, chest pains	Raw milk	Blood	Ingestion of contaminated raw milk, unpasteurized milk (63º C, 30 minutes; 72º C, 15 seconds)

Typhoid fever	*Salmonella typhi* found in feces of infected people	From 7 to 28 days (average of 14 days)	Malaise, headache, fever, cough, nausea, vomiting, constipation, abdominal pains, chills, rose spots, bloody stool	Shellfish, food contaminated by handlers, raw milk, cheese, watercress, water	Stool, rectal swabs, blood	Infected handlers who touch food, poor personal hygiene, improper cooking, inadequate refrigeration, improper wastewater disposal, acquisition of food from contaminated sources, harvesting of shellfish from waters contaminated with sewage
			Viral agents			
Hepatitis A (Infectious hepatitis)	Hepatitis A virus found in the feces, urine, or blood of persons and other infected non-human primates	From 10 to 50 days (average of 25 days)	Fever, malaise, lassitude, anorexia, nausea, abdominal pains, jaundice	Shellfish, any food contaminated with hepatitis virus, water	Urine, blood	Infected workers who touch food, poor personal hygiene, improper cooking, harvesting of shellfish from waters contaminated with sewage, improper wastewater disposal
			Parasitic agents			
Angiostrongyliasis (Eosinophilic meningoencepha-litis)	*Angiostrongylus cantonensis* (lung-worm of rats) found in rodent droppings and the soil	From 14 to 16 days	Gastroenteritis, headache, stiffness of the neck and back, low-grade fever	Crabs, prawns, slugs, shrimp, raw snails	Blood	Improper cooking
Toxoplasmosis	*Toxoplasma*	From 10 to 13	Fever, headache,	Raw or	Lymph nodes	Improper cooking of mutton,

	gondii found in tissues and meat of infected animals	days	myalgia, rash	undercooked meat	(for biopsy), blood	lamb, pork, beef, or veal
Trichinosis	*Trichinella spiralis* found in pork and bear meat	From 4 to 28 days (average of 9 days)	Gastroenteritis, fever, edema around the eyes, myalgia, chills, prostration, difficulty breathing	Pork, bear, walrus	Muscle tissue (for biopsy)	Ingestion of undercooked pork or bear meat, improper cooking or temperatures, feeding pigs garbage that has not been cooked or properly treated with heat

6.1 Incubation period less than one hour

Bacterial agents (and animals)

Scombroid poisoning	Histamine-like substances produced by *Proteus*s spp. Or other histidine bacteria found in fish meat	From a few minutes to 1 hour	Headache, dizziness, nausea, vomiting, peppery taste, burning in the throat, facial flushing and swelling, stomachache, pruritus	Tuna, mackerel, Pacific dolphin	Vomit	Inadequate refrigeration of scombroid fish

Chemical agents

Chinese restaurant syndrome	Monosodium glutamate (MSG)	From a few minutes to 1 hours	Burning sensation in the back of the neck, forearms, and chest; tightness, tingling, facial flushing, dizziness, headache, nausea	Chinese food		Use of excessive quantities of monosodium glutamate to enhance flavor
Niacin poisoning	Sodium nicotinate used as a color preservative	From a few minutes to 1 hour	Reddening, hot flashes, pruritus, abdominal pains, swelling of face and knees	Meat or other foods to which sodium nicotinate has been added		Use of sodium nicotinate to preserve color

6.2 Incubation period from 1 to 6 hours

Poisonous animals

Hypervitaminosis A	Vitamin A	From 1 to 6 hours	Headache, gastrointestinal symptoms, dizziness, collapse, convulsions, insomnia, desquamation of the skin	Liver and kidneys of arctic mammals	Blood	Ingestion of liver or kidneys of animals from cold regions

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[1] The symptoms and incubation period will vary for different individuals or groups owing to: individual resistance, age, and nutritional status; the number of organisms or the concentration of toxic substance in the food ingested; the quantity of food consumed; and the pathogenicity and virulence of the strain of the microorganism or toxicity of the chemical in question. Several diseases manifest symptoms in more than one category, and their incubation periods overlap the generalized ranges described here.

[2] For a more in-depth examination, see Bryan, F.L. (1975). *Diseases Transmitted by Food* (A Classification and Summary). Centers for Disease Control, Atlanta, Georgia.

[3] Samples should be collected from any of the listed foods that have been ingested during the incubation period of the disease.

[4] Carbon monoxide poisoning can resemble some of the diseases included in this category. Patients who have been inside a closed automobile with the motor running or who have been in heated rooms with poor ventilation are at risk of exposure to carbon monoxide.

ANNEX 2

SELECTED FOOD-BORNE DISEASES AS LISTED IN THE INTERNATIONAL CLASSIFICATION OF DISEASES

SELECTED FOOD-BORNE DISEASES
AS LISTED IN THE INTERNATIONAL CLASSIFICATION OF DISEASES

The following list of food-borne diseases is based on the modified Bryan classification (see Table 1 in the main text) and the ninth revision of the International Classification of Diseases. It is recnmmended that this list be used in or~anizinR FBD surveillance systems in Latin America.

Intoxications and infections

ICD Code	Disease
001	Cholera
002	Typhoid and paratyphoid fevers
003	Other salmonella infections. Includes: infection or food poisoning by *Salmonella* (any serotype)
004	Shigellosis
005	Other food poisoning (bacterial). Excludes: toxic effect of noxious foodstuffs (988), *Salmonella* infections (003)
005.0	Staphylococcal food poisoning
005.1	Botulism
005.2	Food poisoning due to *Clostridium perfringens*
005.3	Food poisoning due to other *Clostridia*
005.4	Food poisoning due to *Vibrio parahaemolyticus*
005.8	other bacterial food poisoning. Food poisoning due to *Bacillus cereus.* Excludes: *Salmonella* food poisoning (003)
005.9	Food poisoning, unspecified
006	Amebiasis
007.0	Balantidiasis
007.1	Giardiasis
008	Intestinal infections due to other organisms
008.0	*Escherichia coli*
008.1	*Arizona*
008.2	*Aerobacter aerogenes*
008.3	*Proteus (mirabilis) (morganii)*
008.4	other specified bacteria
008.5	Bacterial enteritis, unspecified
008.6	Enteritis due to specified virus. Enteritis due to: adenovirus and enterovirus
022.2	Gastrointestinal anthrax
023.0	*Brucella melitensis*
023.1	*Brucella abortus*
025	Melioidosis
027.0	Listeriosis
027.8	other [Yersiniosis, Campilobacteriosis]
045	Acute poliomyelitis

070.1	Viral hepatitis A without mention of hepatic coma
100	Leptospirosis
120	Schistosomiasis
121.3	Fascioliasis
122.4	*Echinococcus granulosus* infection, unspecified
123.0	*Taenia solium* infection, intestinal form
123.1	Cysticercosis. Infection by *Cysticercus cellulosae* [larval form of *Taenia solium]*
123.2	*Taenia saginala* infection
123.4	Diphyllobothriasis, intestinal *(D. Iatum* or *pacificum)*
123.6	Hymenolepiasis (nana)
124	Trichinosis
127.0	Ascariasis *(Ascarls lumhricoides)*
127.1	Anisakiasis. Infection by *Anisakis* larva
127.3	Trichuriasis
128.0	Toxocariasis
128.8	Other [Cappilariasis *(Capfllaria hepatfca)]*
130	Toxoplasmosis
136.8	other [Cryptosporidiosis]
984	Toxic effect of lead and its compounds (including fumes)
985	Toxic effect of other metals
985.0	Mercury and its compounds
985.1	Arsenic and its compounds
985.4	Antimony and its compounds
985.5	Cadmium and its compounds
985.8	Other
988	Toxic effect of noxious substances eaten as food. Excludes: toxic effects of food contaminants, such as: aflatoxin and other mycotoxin (989.7), mercury (985.0), food poisoning (bacterial) (005), allergic reaction to food, such as: rash (692.5, 693.1), gastroenteritis (558)
988.0	Fish and shellfish
988.1	Mushrooms
988.2	Berries and other plants
988.9	Unspecified
989.0	Hydrocyanic acid and cyanides. Potassium cyanide [(ingestion of bitter cassava *(Manihot utilissima))]*
989.2	Chlorinated hydrocarbons. Aldrin, Chlordane, DDT, Dieldrin
989.3	Organophosphate and carbamate. Carbaryl, Dichlorvos, Parathion
989.7	Aflatoxin and other mycotoxin [food contaminants]
E865	Accidental poisoning from foodstuffs and poisonous plants. Includes: food additives and contaminants; any meat, fish, or shellfish; plants, berries, and fungi eaten as, or in mistake for, food, or by a child. Excludes: poisoning and toxic reactions to venomous plants (E905.6, E905.7); food poisoning (bacterial) (005)
E865.0	Meat
E865.1	Shellfish
E865.2	Other fish
E865.3	Berries and seeds
E865.4	Other plants

E865.5	Mushrooms and oter fungi
E865.8	Other food
E865.9	Unspecified

ANNEX 3

GLOSSARY

GLOSSARY

DEFINITIONS

Food

Any substance, whether processed, semi-processed, or raw, which is intended for human consumption, including drink, chewing gum, and any other substance which has been used in the manufacture, preparation, or treatment of "food"; does not include cosmetics, tobacco, or substances used only as drugs. (For the purposes of this manual, water is considered a food.)

Outbreak of a food-borne disease (FBD outbreak)

Episode in which two or more people present the same disease after ingesting food (as defined above) from the same origin and where the epidemiological evidence or laboratory tests indicates that such food was the vehicle of said disease.

Family outbreak of FBD

Episode in which two or more contacts or people who live under the same roof present the same disease after ingesting the same food and the epidemiological evidence indicates that such food was the origin of the diseace

Case of FBD

Any person who has become ill after consuming food that is considered to be contaminated based on epidemiological evidence or laboratory testing.

Food-borne disease (FBD)

Syndrome caused by the ingestion of food containing etiologic agents in such quantities that they affect the health of an individual or group. Allergies owing to individual hypersensitivity to certain foods are not considered FBDs.

Food-borne infections

FBDs produced by ingesting food contaminated with specific infectious agents (such as bacteria, virus, fungi, or parasites) that can multiply in the intestine, break down and produce toxins, or penetrate the intestinal wall and spread to other organs or systems.

Food poisoning

FBDs produced by ingesting toxins from plant or animal tissues, metabolic products of microorganisms in food, or chemicals that are added to foods accidentally, incidentally, or intentionally at any point between the time the food is produced and the time it is consumed.

FBD surveillance system

A simple, timely, and continuous information system covering specific diseases that are transmitted through the consumption of food. It includes investigation of the determining factors and causative agents of the disease, as well as analysis of the situation so as to formulate action strategies for prevention and control. The system should also be flexible, acceptable, responsive, and representative.