Pan American Health Organization

World Health Organization

REGIONAL OFFICE FOR THE Americas

Webinar Recommendations

- Please turn off your microphones
- There will be a one hour presentation and additional time and answers
- Questions should be sent in writing, through the chat or by email to: Infectioncontrol@paho.org
- The presentation will be available on PAHO website in 48 hours

Acknowledgement

The webinar is made possible by the auspices and cooperation of the Infection Control Center(CDC), according to the cooperation agreement CDC-RFA-CK13-1302. “BUILDING CAPACITY AND NETWORKS TO ADDRESS EMERGING INFECTIOUS DISEASES IN THE AMERICAS”

Introduction to Outbreak Investigations of Healthcare-Associated Infections

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International Infection Control Program

U.S. Centers for Disease Control and Prevention

PAHO Webinar

February 13, 2018

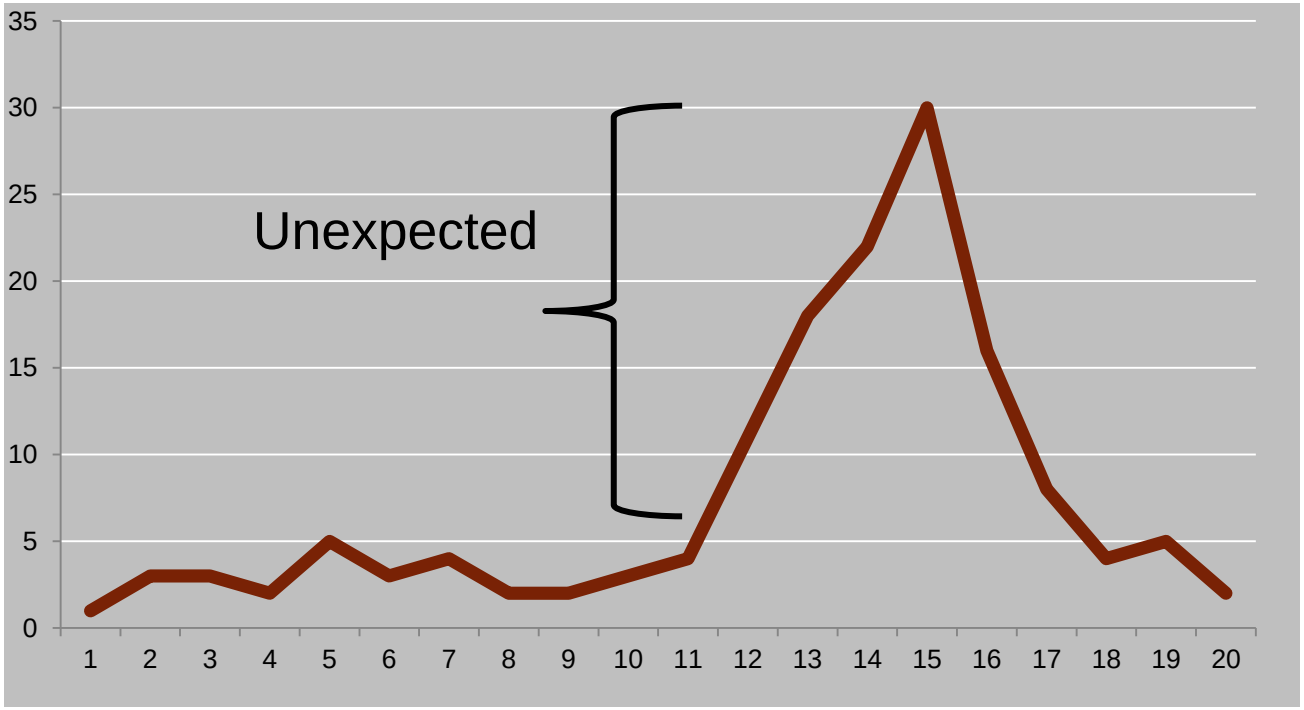
NO DISCLOSURES

Objectives

- Define an outbreak
- Describe epidemiologic and lab methods for investigating outbreaks in healthcare settings
- Discuss effective strategies to manage and control an outbreak of healthcare-associated infections

What is an outbreak?

- The occurrence of more cases of a disease than expected for a particular place and time



Identifying a potential outbreak

- Review of surveillance data
- Clinician reports of unusual diagnoses
- Reports from the public
- Media

Example: outbreak of multi-drug resistant *Acinetobacter baumannii*

- An infection control practitioner working in a mid-sized community hospital noticed a cluster of 4 patients with multi-drug resistant *Acinetobacter baumannii* infections
- All infections occurred in the 16-bed intensive care unit
- All of the isolates were highly resistant, with some reported to be resistant to colistin

Why investigate HAI outbreaks?

- Identify the cause of the outbreak
- Control the outbreak
- Prevent similar outbreaks in the future
- Provide new research and insight
- Evaluate existing prevention strategies
- Address public concerns
- Minimize economic and social disruptions

Should you investigate?

Depends on:

- Severity of illness
- Potential for spread
- Political considerations
- Public relations
- Resource availability
- Availability of prevention and control measures

Conducting an HAI Outbreak Investigation

Essential investigation components

1. Verify the diagnosis / confirm the outbreak
2. Inform key partners
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11. Communicate results (staff, patients, press, public)

One thing to remember…

- Outbreak investigations are neither linear nor orderly
- Multiple steps happen simultaneously
- Steps often have to be repeated several times

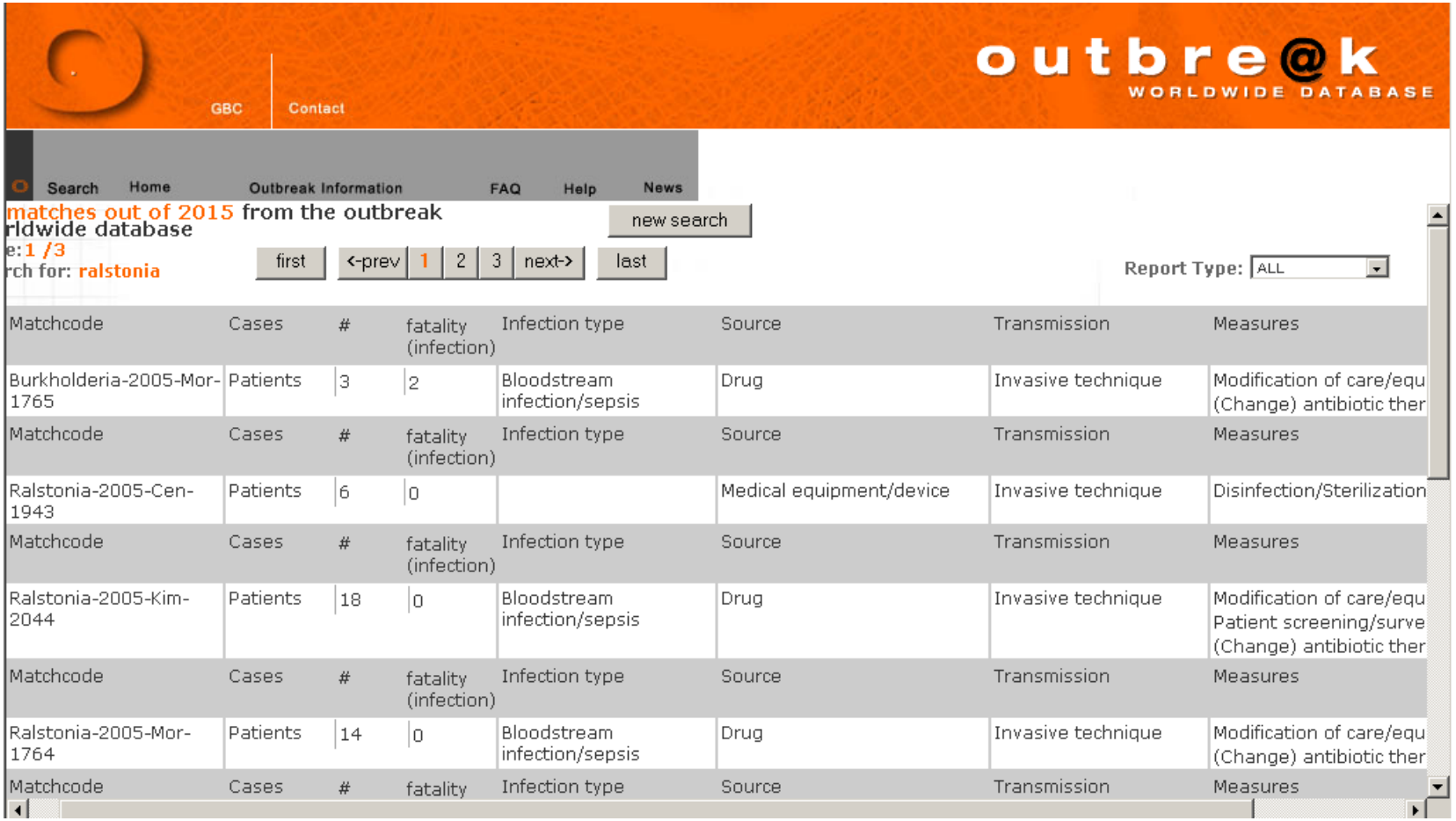
Before you begin

- Talk to the lab and ask them to save ALL isolates that might be part of the outbreak!

Literature review

- Is an important place to start
- There are LOTS of published outbreak investigations- more than 50,000
- You will get good leads both on where and how to start your investigation

A great resource



Matchcode	Cases	#	fatality (infection)	Infection type	Source	Transmission	Measures
Burkholderia-2005-Mor-1765	Patients	3	2	Bloodstream infection/sepsis	Drug	Invasive technique	Modification of care/equ (Change) antibiotic ther
Matchcode	Cases	#	fatality (infection)	Infection type	Source	Transmission	Measures
Ralstonia-2005-Cen-1943	Patients	6	0		Medical equipment/device	Invasive technique	Disinfection/Sterilization
Matchcode	Cases	#	fatality (infection)	Infection type	Source	Transmission	Measures
Ralstonia-2005-Kim-2044	Patients	18	0	Bloodstream infection/sepsis	Drug	Invasive technique	Modification of care/equ Patient screening/surve (Change) antibiotic ther
Matchcode	Cases	#	fatality (infection)	Infection type	Source	Transmission	Measures
Ralstonia-2005-Mor-1764	Patients	14	0	Bloodstream infection/sepsis	Drug	Invasive technique	Modification of care/equ (Change) antibiotic ther
Matchcode	Cases	#	fatality	Infection type	Source	Transmission	Measures

http://www.outbreak-database.com/Home.aspx

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Verify the diagnosis

Evaluate the clues:

- ✓Signs and symptoms
- ✓Laboratory findings
- ✓Duration of symptoms
- ✓Suspected exposure
- ✓Suspected virus, bacteria, or toxin
- ✓Hospital onset

Laboratory confirmation

- Most definitive method for verifying diagnosis
- May help define the incubation period
- Interpret negative results with caution:
  - Organism may not have been tested
  - Specimens collected too late in illness
  - Mishandling of specimen

Look for an increase in case reports

- Review the reports and data
- Confirm that cases are the same disease
- Confirm that the number of cases exceeds the normal
- Confirm healthcare onset

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Inform key partners

- Facility staff
  - ✓ Infection control staff
  - ✓ Administration
- Laboratory staff
  - ✓ Save ALL isolates
- Local and national public officials as appropriate

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Case definition

- Elements of a case definition
  - Clinical criteria (signs and symptoms)
  - Person, place, and time criteria
  - Laboratory tests
- Can be based on
  - Etiologic agent
  - Signs and symptoms of infection
- How narrow to make it depends on the pathogen and setting

Case definition examples

A patient who developed a surgical site infection after undergoing shoulder surgery at Hospital A between December 31,2012 and January 1, 2013

Any patient who developed an MRSA bloodstream infection in the neonatal intensive care unit between Jan 1 and Dec 31

Case definition: MDR-Ab example

- A patient hospitalized at Hospital A from July 2006 to June 2007 who had at least one culture positive for MDR-Ab
- Included patients with either infection or colonization
- First culture had to be obtained 48 hours after admission
- MDR-Ab defined as *A. baumannii* with resistance to 2 or more of 5 drug classes

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Active case finding

- Many outbreaks first recognized by healthcare personnel
- Active case finding requires casting a wide net at the beginning of the investigation
- Helps provides more information about the outbreak and define the exposed population

How do you find cases?

- Microbiology data
- Infection control or surveillance records
- Discussions with clinicians
- Medical records
- Operative notes
- Pathology reports
- Pharmacy records
- Radiology reports
- Central service/supply records
- Occupational health records
- Hospital billing records
- Purchasing Records
- Log Books

In our *Acinetobacter* example…

- Obtained monthly *Acinetobacter* susceptibility report from laboratory from July 1, 2006 to June 19, 2007
- Searched for all cultures that met the definition for MDR-Ab
- Identified all patients with initial culture 48 hours after hospital admission

How hard should I look?

- Remember, goal of investigation is to stop the outbreak, not necessarily to uncover every case

- More exhaustive case findings efforts may not be needed up front, but might become important if you can't get things under control quickly

Data collection

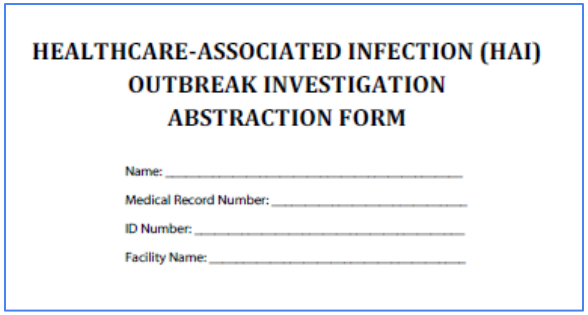
- Identifying information
- Demographic facts
- Clinical information
- Risk factor information

Questionnaire may include potential risk factors or exposures

- Medications
- Procedures
- Dates of admission and discharge
- Consultants
- Facility locations or units
- Health care providers
- Host factors (age, gender, immunity)

Case abstraction form

- Systematic collection of case-patient information
- Abstracts data from patient chart and laboratory, radiology
- Designed specifically for investigation to describe cases and potential risk factors depending on type of infection



HEALTHCARE-ASSOCIATED INFECTION (HAI)
OUTBREAK INVESTIGATION
ABSTRACTION FORM

Name: _____

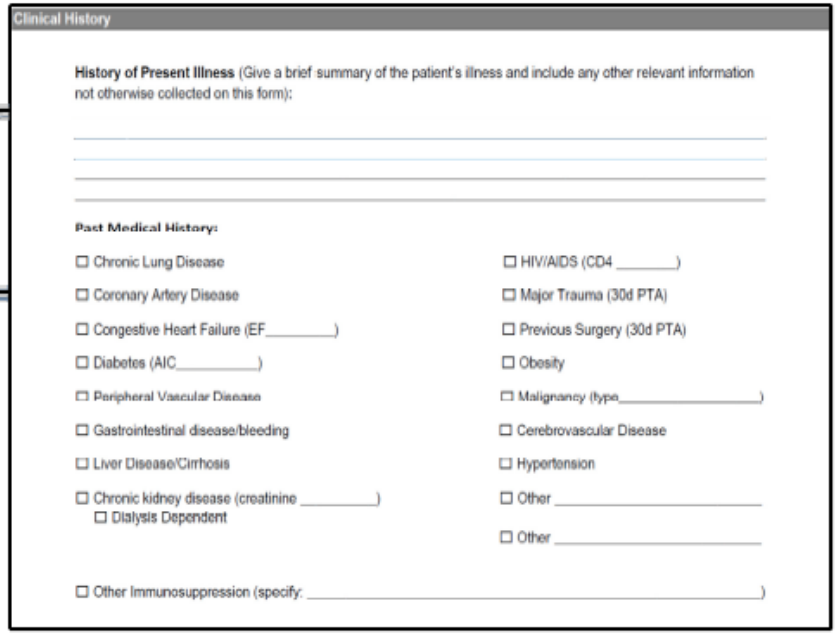
Medical Record Number: _____

ID Number: _____

Facility Name: _____

http://www.cdc.gov/hai/outbreaks/outbreaktoolkit.html

Case abstraction form



Clinical History

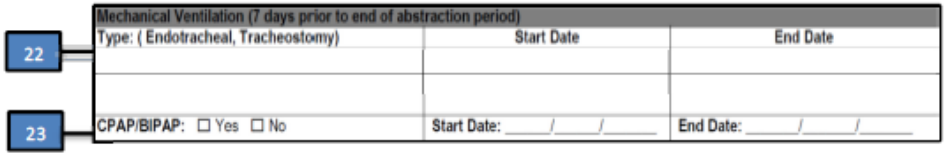
History of Present Illness (Give a brief summary of the patient's illness and include any other relevant information not otherwise collected on this form):

8

Past Medical History:

9

- ☐ Chronic Lung Disease
- ☐ Coronary Artery Disease
- ☐ Congestive Heart Failure (EF_____)
- ☐ Diabetes (AIC_____)
- ☐ Peripheral Vascular Disease
- ☐ Gastrointestinal disease/bleeding
- ☐ Liver Disease/Cirrhosis
- ☐ Chronic kidney disease (creatinine _____)
  - ☐ Dialysis Dependent
- ☐ HIV/AIDS (CD4 _____)
- ☐ Major Trauma (30d PTA)
- ☐ Previous Surgery (30d PTA)
- ☐ Obesity
- ☐ Malignancy (type_____)
- ☐ Cerebrovascular Disease
- ☐ Hypertension
- ☐ Other _____
- ☐ Other _____
- ☐ Other Immunosuppression (specify: _____)



22

23

Mechanical Ventilation (7 days prior to end of abstraction period)		
Type: (Endotracheal, Tracheostomy)	Start Date	End Date
CPAP/BiPAP: ☐ Yes ☐ No	Start Date: ____/____/____	End Date: ____/____/____

24. Devices: -Complete the following table if patient had contact with the listed devices. If a device is not listed, write it in the "Other" box. Abstractor should record the site, date inserted, and date removed.

24

Devices (7 days prior to end of abstraction period)			
Device	Site	Date Inserted	Date Removed
☐ Central Venous Catheter			
☐ Central Venous Catheter			
☐ Central Venous Catheter			
☐ Condom Catheter			
☐ Foley Catheter			
Feeding Tube: ☐ Nasogastric /Nasoduodenal ☐ PEG/PEJ (stomach)			
☐ Other			

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Descriptive epidemiology

- Who is at risk?
  - Describe data by person, place, time
- Characterizes the outbreak
- Identifies the population at risk
- Provides clues about the agent, source, or mode of transmission
- Provides information to begin control measures
- Familiarizes the investigator with the data

Linelist

- Created from case data
  - Each row is a case
  - Each column is a variable of interest:
    - Signs and symptoms, onset date – is this an outbreak?
    - Medications, intravenous solutions
    - Invasive procedures, surgery
    - Consults, staff contact
    - Host factors (e.g. age, underlying disease?)
    - Lab results
- **Arguably the single most important part of the investigation since it drives all the investigation efforts!**

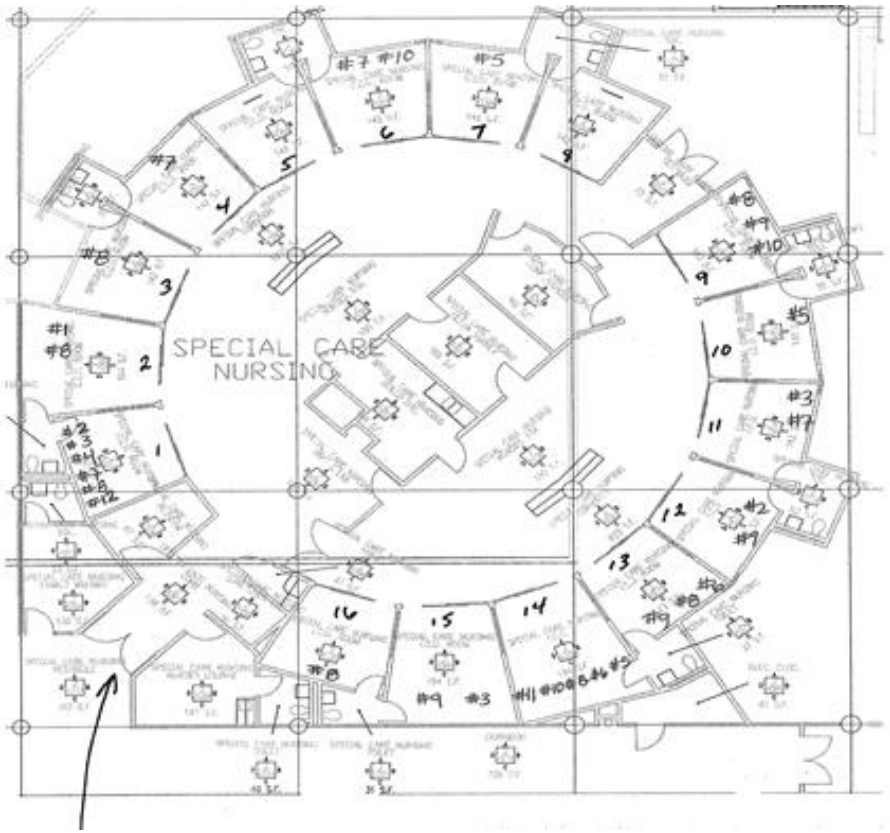
Example of a linelist

Table 6.4 Line Listing of 26 Persons with Symptoms — School District A, December 2003

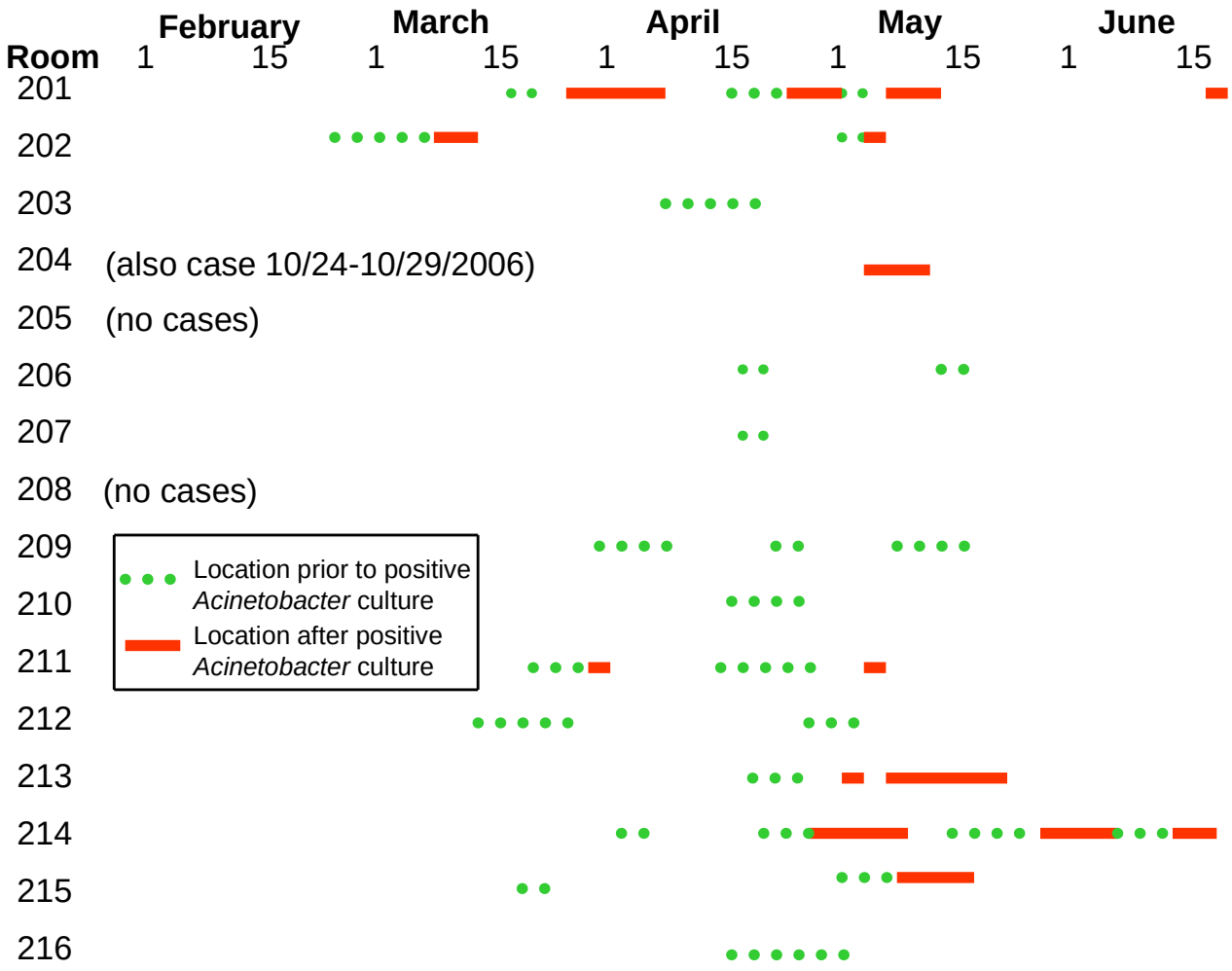
Patient #	Grade & School	Age	Sex	Tour	Onset Date	Severe Abdominal Pain?	No. Times Diarrhea	Stool Testing
1	10 – 1	17	M	A	Dec. 8	Y	3	Not done
2	10 – 1	16	F	A	Dec. 6	N	1	Negative
3	10 – 2	16	M	A	Dec. 10	Y	2	*E. coli* O157
4	10 – 2	17	F	A	Dec. 8	Y	3	Not done
5	10 – 2	16	F	A	Dec. 5	Y	8	*E. coli* O157
6	10 – 2	16	M	A	Dec. 6	Y	3	Not done
7	10 – 3	17	M	A	Dec. 7	Y	4	Not done
8	10 – 3	17	F	A	Dec. 8	Y	2	*E. coli* O157
9	10 – 3	16	F	A	Dec. 7	Y	3	Negative
10	10 – 4	17	F	A	Dec. 7	Y	2	*E. coli* O157
11	10 – 4	16	M	A	Dec. 8	Y	3	Not done
12	10 – 4	16	M	A	Dec. 9	Y	3	Negative
13	10 – 5	16	F	A	Dec. 8	Y	3	Not done
14	10 – 6	17	F	B	Dec. 8	Y	3	*E. coli* O157
15	10 – 6	16	F	B	Dec. 9	Y	2	Negative
16	10 – 7	17	F	B	Dec. 6	Y	3	Not done
17	10 – 7	17	F	B	Dec. 7	Y	5	*E. coli* O157
18	10 – 7	16	F	B	Dec. 8	Y	2	Negative

Describe the data by “place”

- ICU room layout with room numbers and case-patient locations, Hospital A



Describe the data by “place”

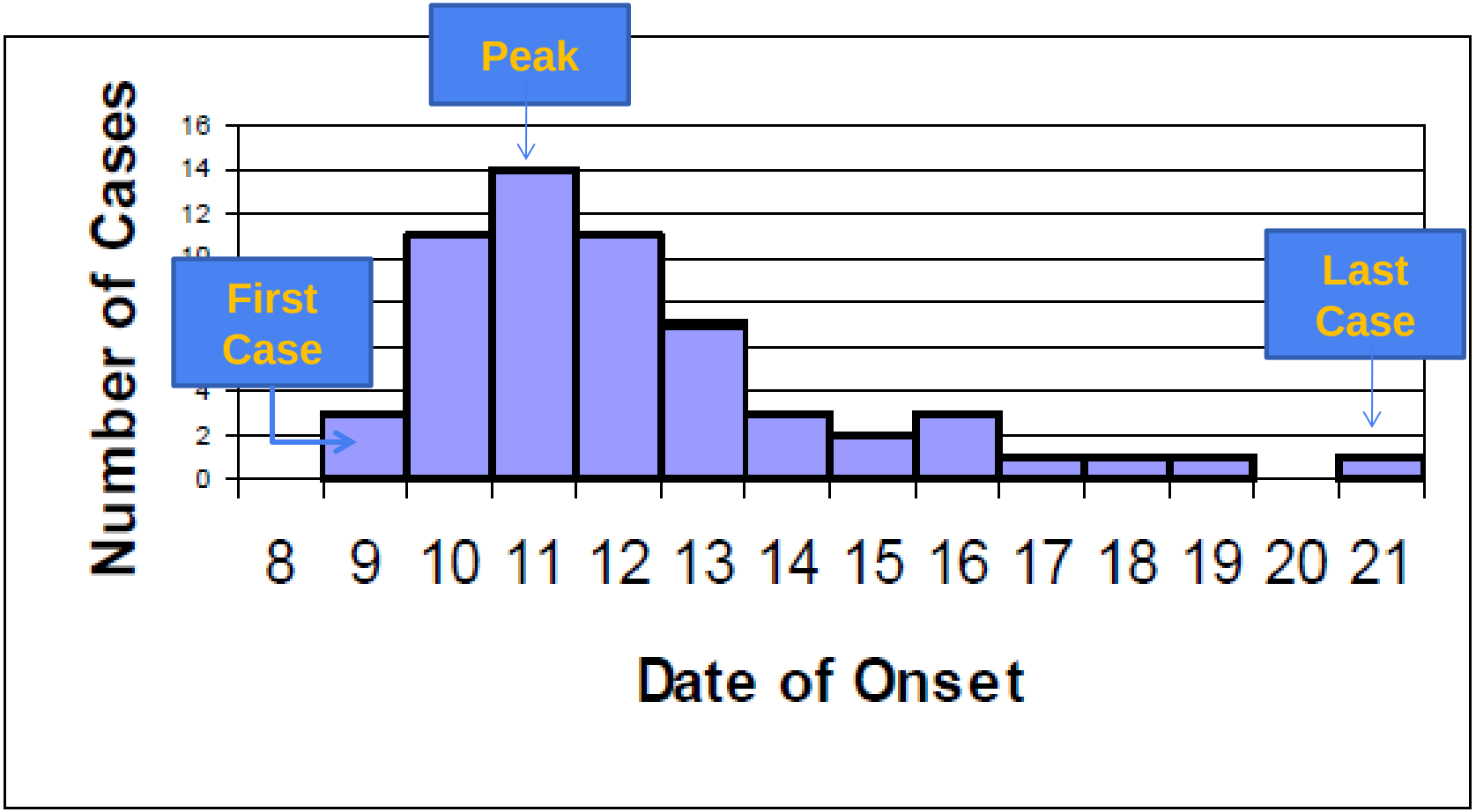


Describe the data by “time” -- Epidemic curve

- An epidemic curve is a graphical display of the number of incident cases in an outbreak, plotted over time
  - Y-axis: Number of cases of illness
  - X-axis: Date or time of illness onset

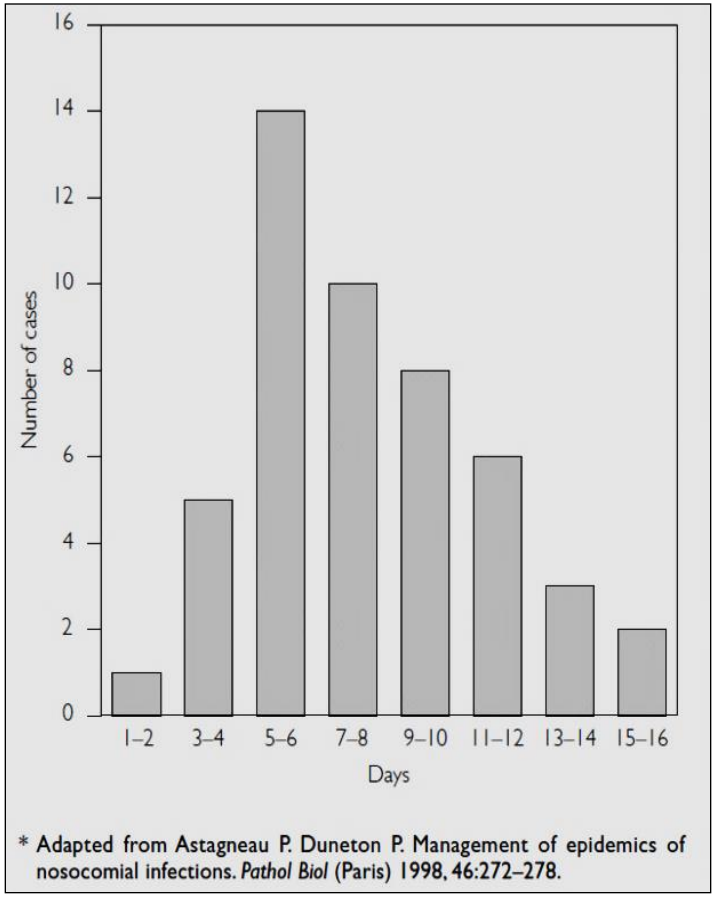
- Provides important information:
  - Magnitude and time trend of the outbreak
  - Help define the incubation or exposure period
  - Show the pattern of spread
  - Highlight outliers

Course of an outbreak



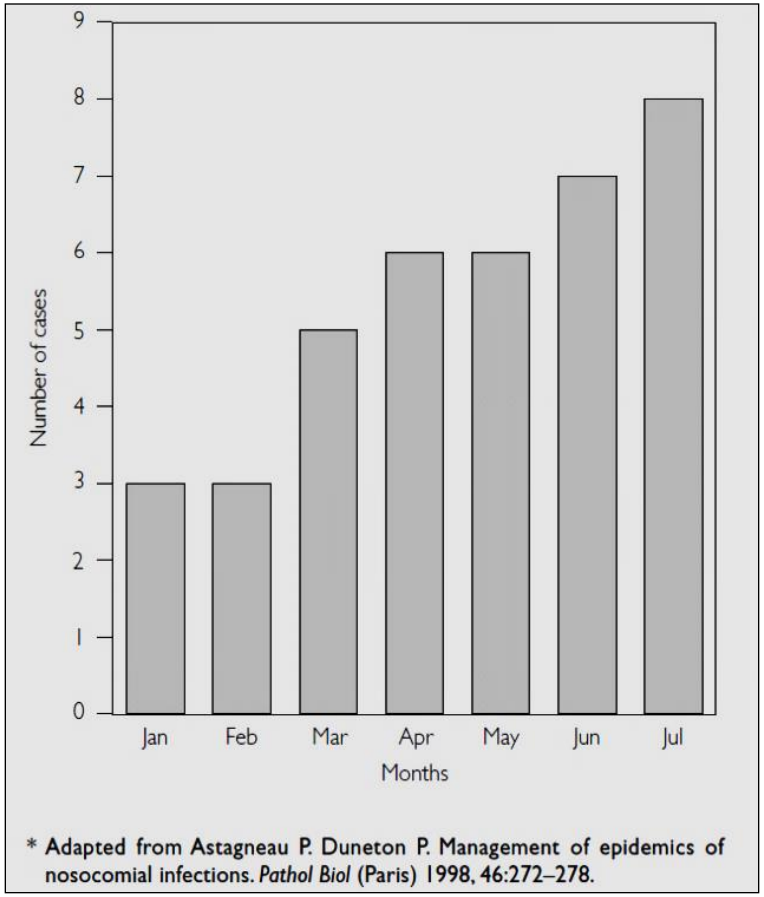
Interpreting the epidemic curve

Single Point Source



* Adapted from Astagneau P. Duneton P. Management of epidemics of nosocomial infections. *Pathol Biol* (Paris) 1998, 46:272–278.

Common Continuous Source



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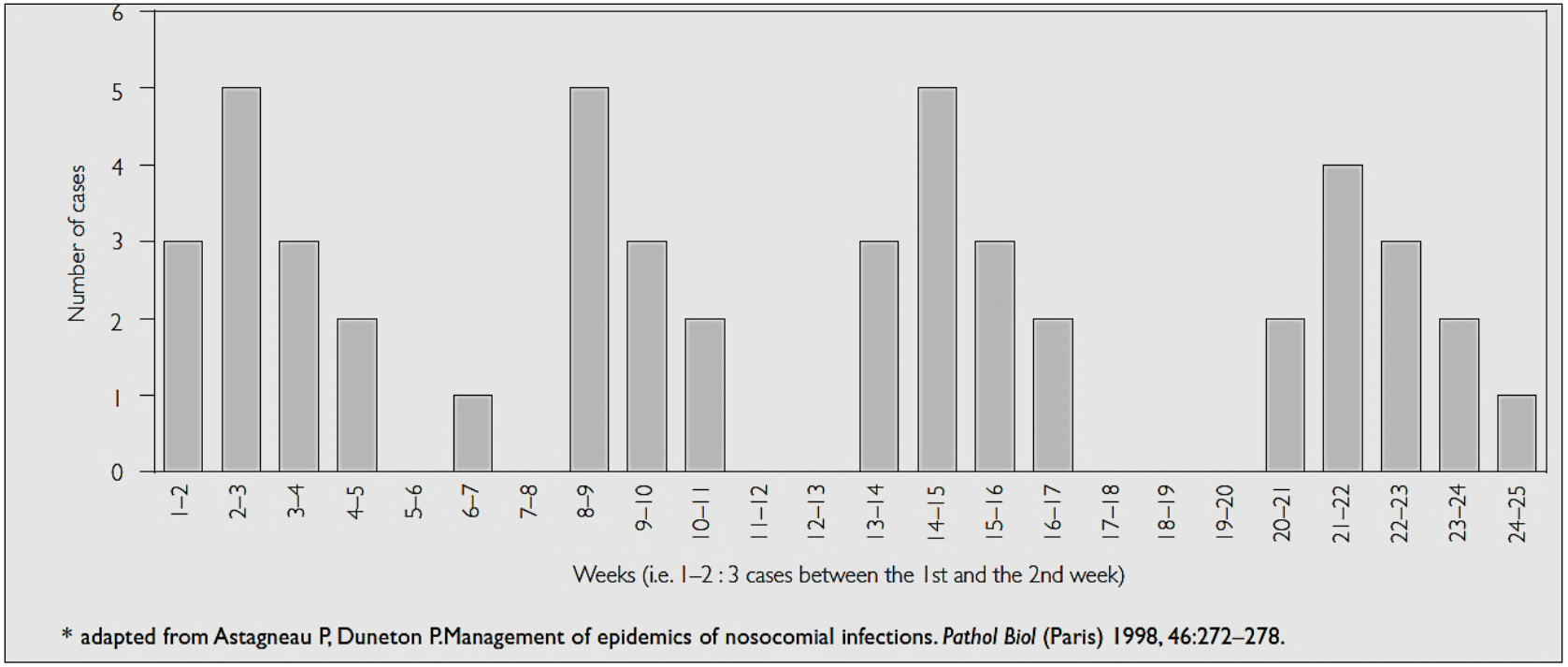
Interpreting the epidemic curve

Intermittent source infection



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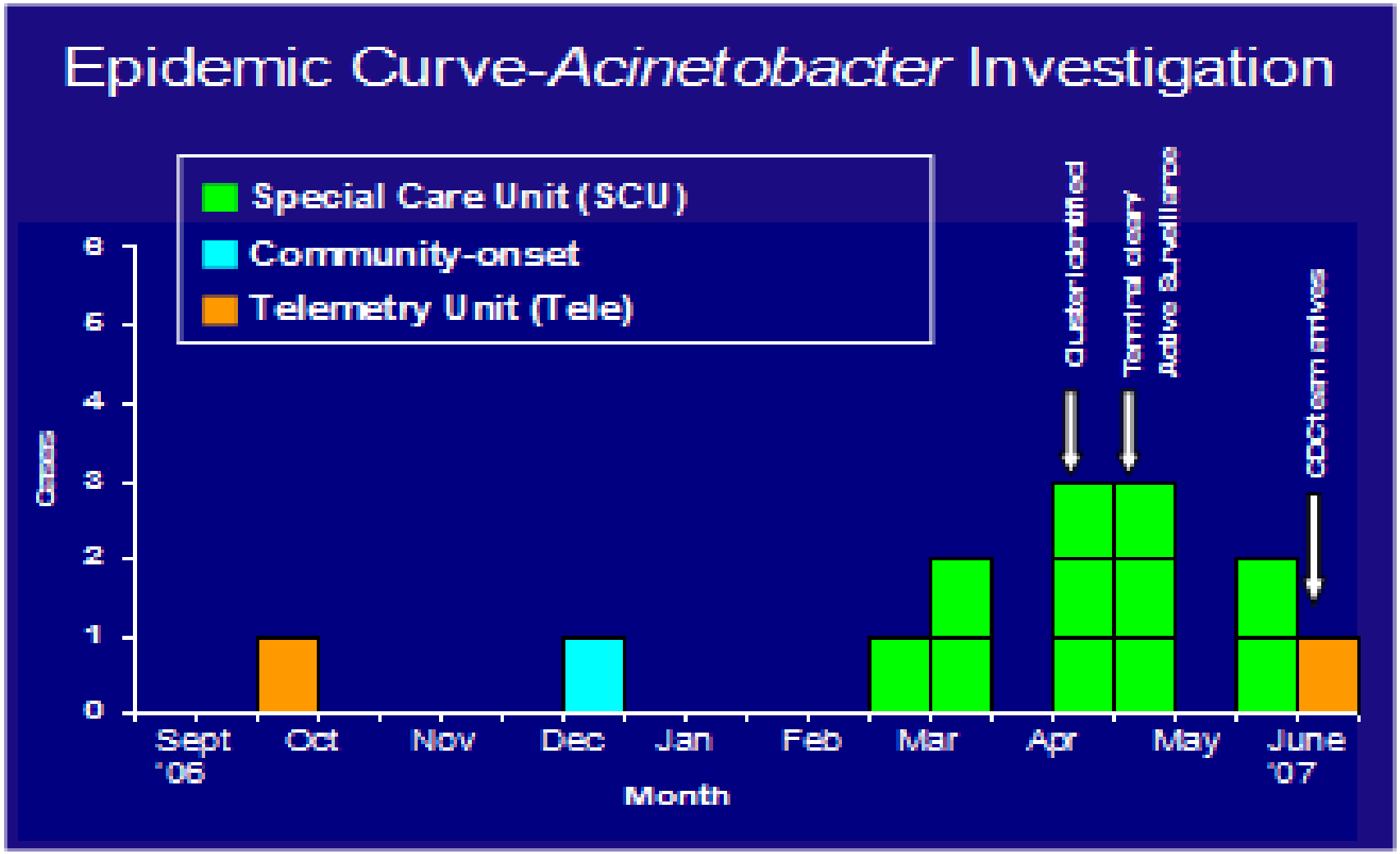
In our example…



Outliers

- An early case or a late case
- May represent unrelated incident
- Worth examining carefully
- May point directly to the source

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Clinical observations

- Who and what to observe is generally driven by the line list

- Observations can include
  - Medication preparation
  - Vascular access care
  - Hand hygiene practices
  - Adherence to isolation precautions
  - Surgical practices
  - Respiratory care practices

What am I looking for?

- How does actual practice compare to written (or verbal) protocols?
- Do different people do the same thing in different ways?
- Create a standard observation tool, if needed

Ask lots of questions to lots of people!

- Do you always do it that way?
- Have you seen other people do it differently?
- What are the challenges with maintaining good techniques?
- What do you think is causing the outbreak?
- What procedures or medications might I be missing because they are not in the chart or done infrequently?

In our *Acinetobacter* example…

- Investigation team toured affected units
- Conducted in-depth interviews of staff
- Observed housekeeping cleaning room after patient discharge
- Observations:
  - Hand sanitizer readily available, but compliance ~ 35%
  - Nebulizer cups not always removed, rinsed, dried
  - Many open syringes and medication vials
  - Inoperable sink with mold growth
  - Poor cleaning of portable x-ray and ultrasound machines

In our *Acinetobacter* example

- Glo Germ™: small particles that fluoresce with UV light
- Applied to high-touch surfaces in 2 rooms following discharge

Room Location	Surfaces adequately cleaned*	Surfaces partially cleaned†	Surfaces not cleaned‡
Telemetry	Phone receiver	Bedside table	TV remote/Call button
		Bed rail (top)	Mattress (top)
			Sink faucet
			Toilet flusher
SCU	Bedside table	IV pump #2	Bed rail (top)
	Bed control buttons on side bed rail		TV remote/Call button
	IV pump #1		Shelf next to bed
	Mattress (top)		

*Glo Germ™ completely removed, †Glo Germ ™ smudged or faintly visible by UV light, ‡Glo Germ ™ clearly visible under UV light

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Generate a hypothesis

- An educated guess about an association between an exposure and outcome
- Usually generated based on your descriptive data (linelist) and observations of infection control and patient care activities
- Comparing hypotheses with established facts
  - Laboratory evidence
  - Clinical evidence
  - Environmental evidence
  - Epidemiologic evidence

Acinetobacter example: hypothesis generation

- MDR *Acinetobacter* was transmitted in two units in Hospital A because of poor cleaning and disinfection practices of high-touch surfaces, including portable radiology machines

Portable x-ray procedures

Film cassettes come in contact with the drawer lining and other cassettes

Techs often make direct contact with patients during positioning

Cassette makes direct contact with bedding and possibly with patient skin

Slide courtesy A. Kallen

Analytic study

- Hypotheses can be tested in an analytic study, such as a case-control study that compares exposures among case patients to hospital-matched controls
- In many cases, a study is “icing on the cake,” but not necessary to control the outbreak
- Can be helpful in guiding more investigation when source remains unclear or to support a hypothesis

Our example: Risk factors for MDR-Ab acquisition

Exposure, median (range)	Cases (N=13)	Controls (N=30)	p-value
Number of portable x-rays†	**8 (1-10)**	**4 (0-11)**	**0.03**
Antibiotics days‡	**12 (5-30)**	**8 (0-37)**	**0.03**
Days ventilated‡	**10 (0-25)**	**1 (0-39)**	**<0.01**

† for one week prior to culture in both cases and controls,

‡for entire admission prior to culture in cases and for entire admission in controls

Slide courtesy A. Kallen

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Environmental sampling

- Can be a powerful and definitive aspect of an investigation

- But can also be expensive, misleading and frustrating
  - Does a negative culture mean the bug was never there or just is not there right now?
  - Did we culture the right things?

Environmental cultures: suggestions

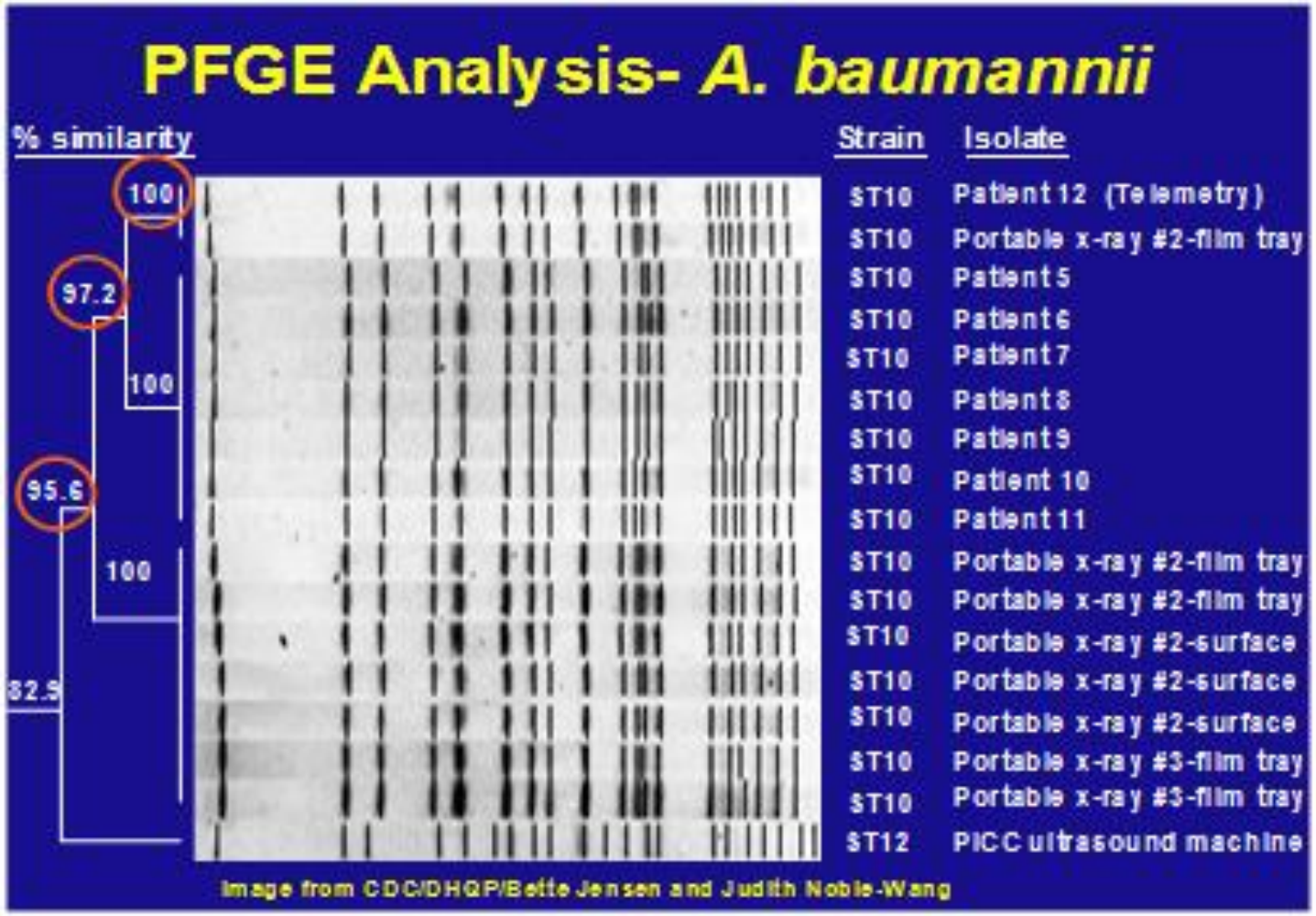
- ***Remember: the environment is big, the swab is small!***
- Culture *after* you have data from the line list and observations
- Talk with the lab about optimal methods
- Culture only things that are likely routes of transmission (high-touch surfaces!)
- Culture what makes sense for the organisms (e.g., *Serratia* – fluids, VRE- objects/surfaces)

Acinetobacter investigation: environmental sources

- 2 environmental samples positive: *A. baumannii*
  - Portable x-ray machine
  - Portable ultrasound machine
- Case isolates indistinguishable to x-ray machine isolates
- All isolates multi-drug resistant

Slide courtesy A. Kallen

Acinetobacter investigation: pulsed-field gel electrophoresis (PFGE)



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Implementing control measures

- Ultimately, primary goal is to stop transmission, not necessarily to find the source

- It's okay to implement a variety of control measures targeting various possibilities based on initial observations

- Examples:
  - Identify and remove common source (e.g, contaminated meds)
  - Reinforce hand hygiene
  - Enhanced cleaning
  - Isolate infected/ colonized patients

Acinetobacter control measures

- Appropriate cleaning and disinfection of high-touch surfaces (using findings from Glo-Germ exercise as teaching points)
- Reinforce hand hygiene adherence
- Hospital cleaning protocol for mobile radiology equipment
- Additional recommendations for infection control staffing, general infection control procedures, and surveillance

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Communicate findings

- During the investigation
  - Among team members
  - To the public
  - To health professionals
  - To public health officials/ policy makers
- At the end of the investigation
  - Oral briefing
  - Written report

Constraints of outbreak investigations

- Urgency to find source and prevent cases
- Pressure for rapid conclusion
- Limited human or environmental samples for testing
- For analytic studies, statistical power often limited
- Media reports may bias interviewees
- Pressures because of legal liability

Conclusions

- Outbreaks remain a major detriment to the safety of patients and healthcare workers and can have substantial massive financial and public relations impacts
- Sentinel events that help us understand and confront emerging challenges in healthcare
- Play an important role in making recommendations that improve overall patient care and provide important opportunities for education

Thank you!

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

Next Webinar

March 13 - 2pm EST

"Prevention of Bloodstream Infection in Neonatology"

Dr. Roseli Calil

University of Campinas, Brazil