

Factors and Determinants Associated with Malaria Reemergence Epidemics

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Agenda

- **Discuss some thoughts about malaria reemergence**
- **Present recent malaria outbreaks**
- **Comment lessons learned from these different episodes**
- **Discuss what can be done to prevent or respond to such events**

Malaria Reemergence

- **Receptivity**
 - Presence of vectors, and ecological/climatic conditions favorable to malaria transmission
 - How capable area is to allow for transmission
- **Vulnerability**
 - Proximity to malarious areas or possibility of influx of malaria patients or vectors
 - Possibility of malaria parasite introduction

Malaria Cycle

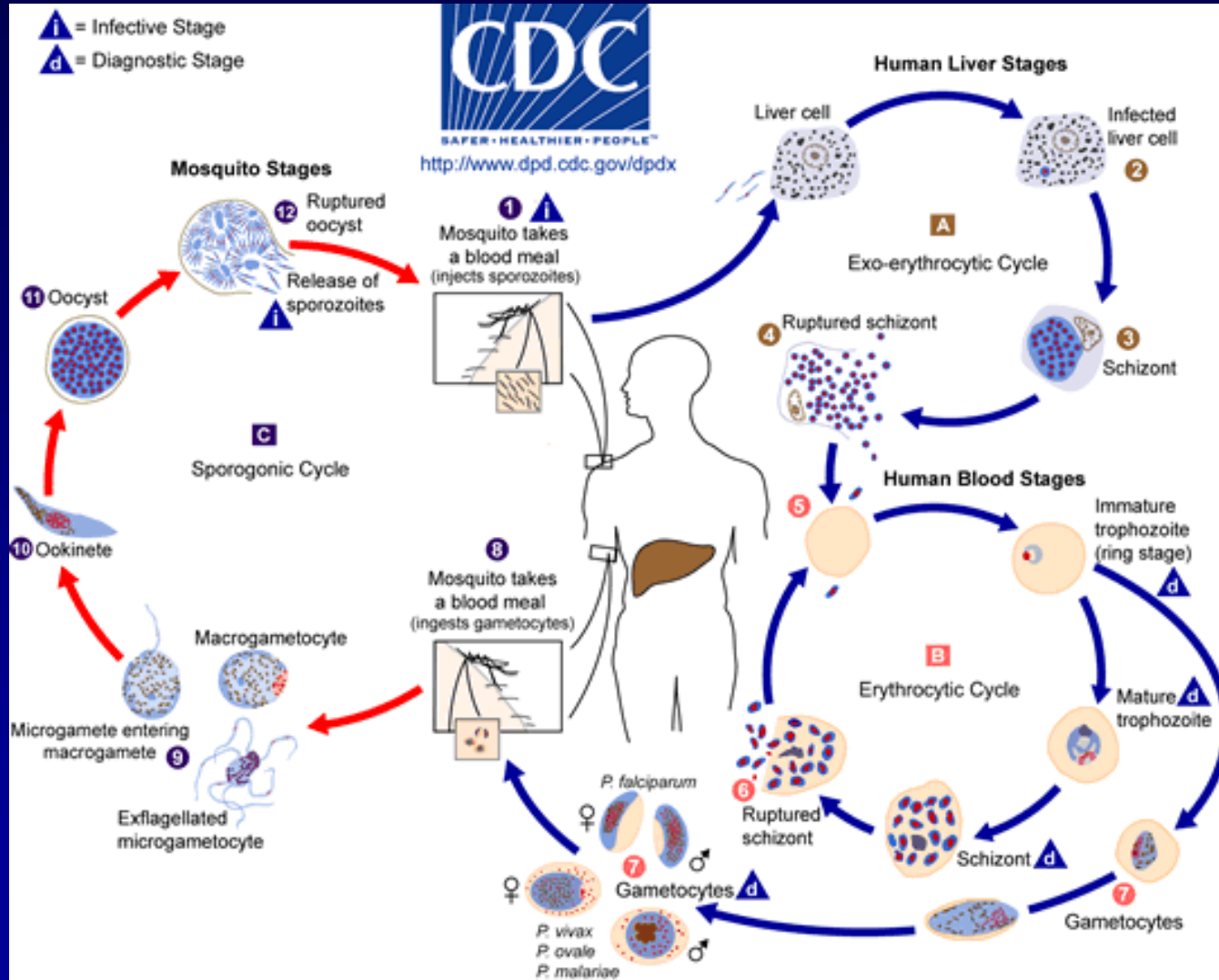
- **Vector**

- *Anopheles mosquito, definitive host*
- Different mosquito species with different preferences and habits
- Environment and climate condition

- **Human**

- Intermediate, reservoir
- Moveable populations (travelers, immigrants, special populations, etc)

Malaria Cycle



Opportunities for Transmission Interruption

- **Vector control**
 - **Better housing (screens)**
 - **Water management**
 - **Insecticide-based strategies**
- **Case management**
 - **Timely diagnosis and treatment**
 - **Gametocidal drugs**
- **Border control**
 - **Screening at ports of entry**

Malaria in Afghanistan, 2001–2005

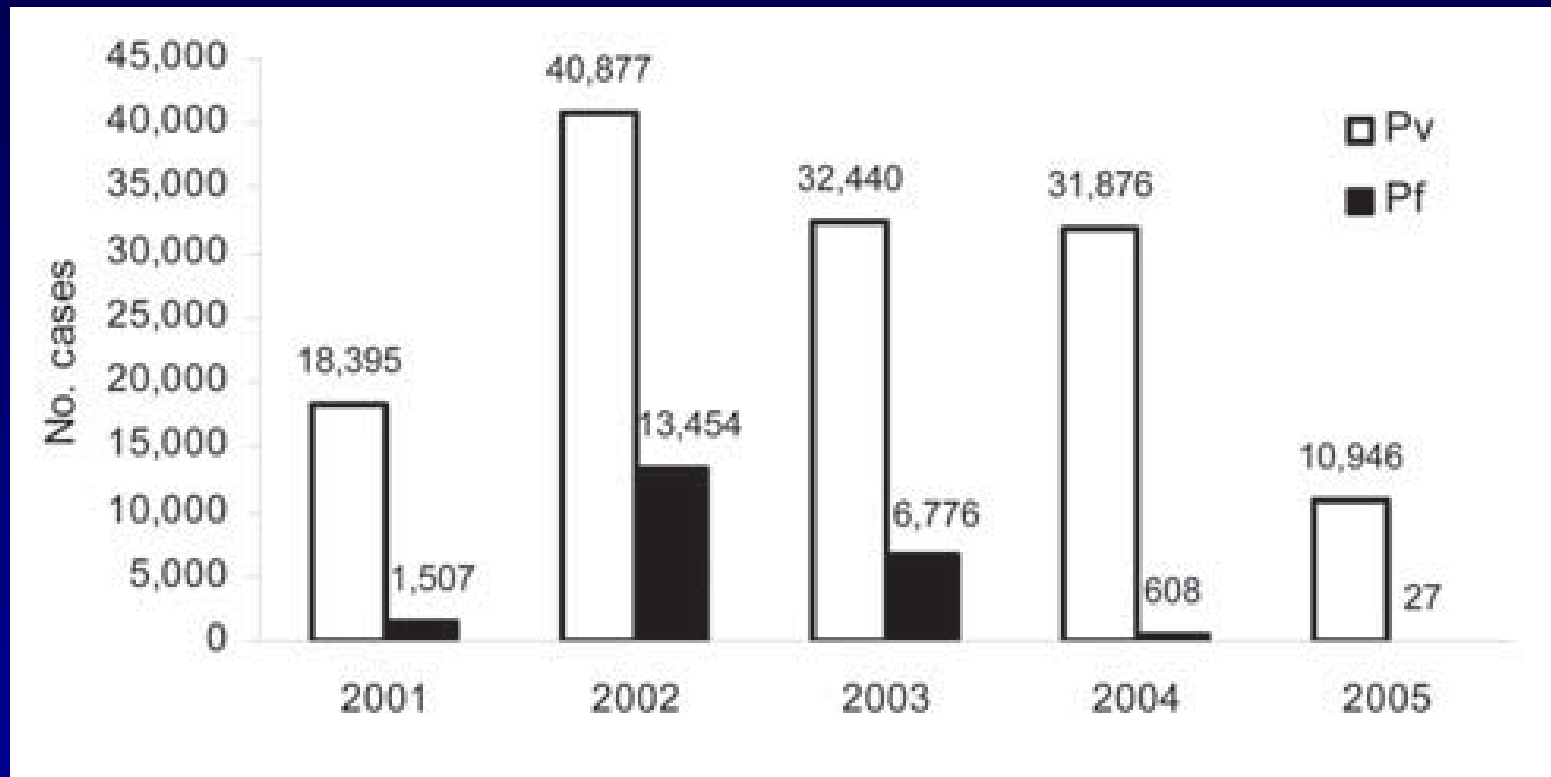


Figure. *Plasmodium vivax* (Pv) and *P. falciparum* (Pf) cases in Kunduz Province, northern Afghanistan, January 2001–December 2005. (Faulde et al, 2007)

Malaria in Afghanistan, 2001–2005

- **Conclusion**

- Malaria reintroduction by resettling refugees
- Environmental changes by rice growing (*P. vivax*)
- Increase in anophelines
- Limited vector control

- **Lesson learned**

- Risk of reemergence associated with environmental changes

Malaria in Trinidad, Late 1990s

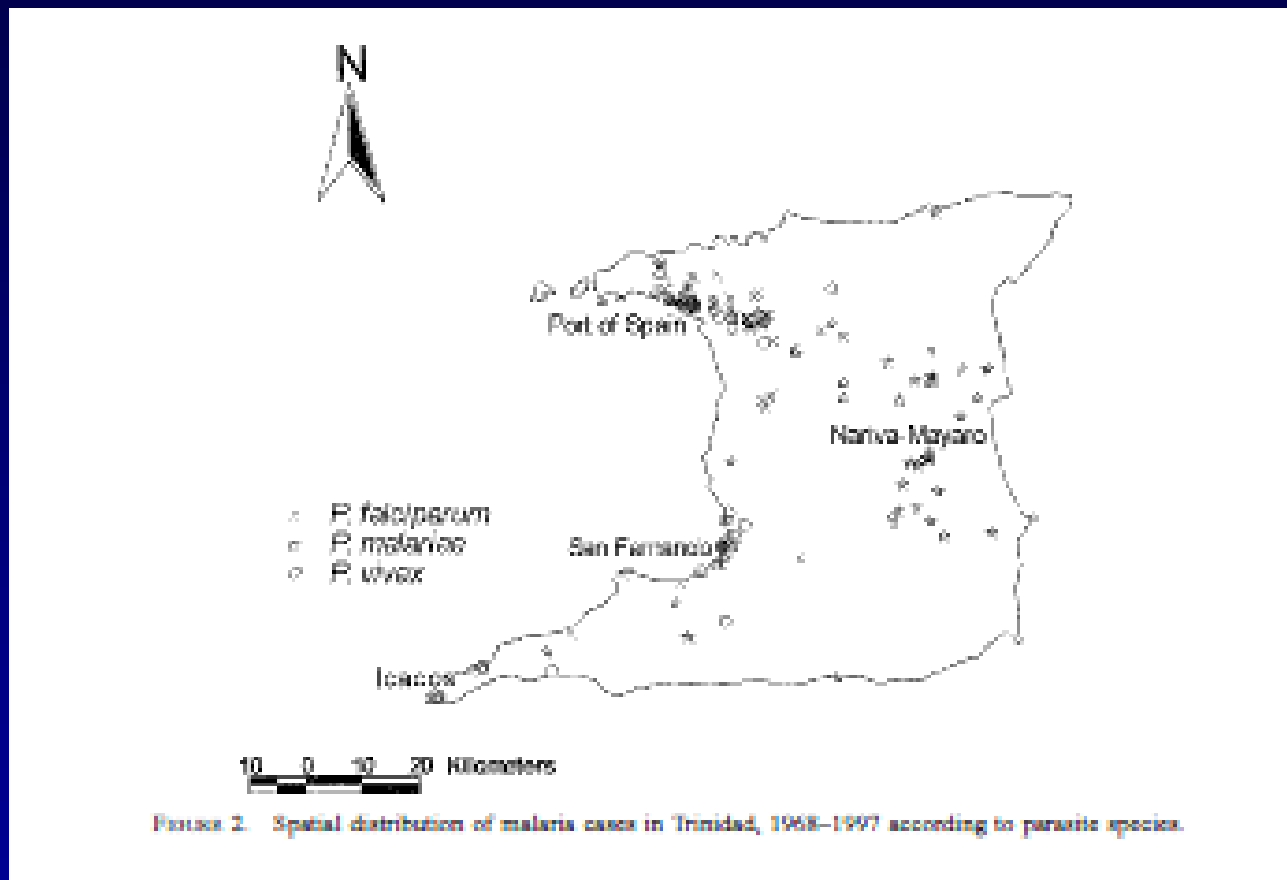


FIGURE 2. Spatial distribution of malaria cases in Trinidad, 1968–1997 according to parasite species (Chadee, 1999).

Malaria in Trinidad, Late 1990s

- Findings

- 213 cases from 1968 to 1997
- *P. vivax* cases in coast (almost all imported)
- *P. malariae* cases in interior (locally acquired)
- Different vectors
 - *An. aquasalis* as main vector in coast
 - *An. bellator*, *An. hamuncules* (bromelia vectors)

Malaria in Trinidad, Late 1990s

- **Lessons learned**
 - **Importance of malaria surveillance**
 - **Mapping cases to understand geographical distribution**
 - **Vector information**
 - **Different risk factors for simultaneous foci**

Malaria in Jamaica, 2006–2009

- 401 *P. falciparum* cases during Sep 2006–Dec 2009
- Response
 - Intense case finding
 - Passive reporting, fever surveillance, case contact investigation
 - Chloroquine and primaquine for treatment
 - Vector control
 - Larviciding, spraying

Malaria in Jamaica, 2006–2009

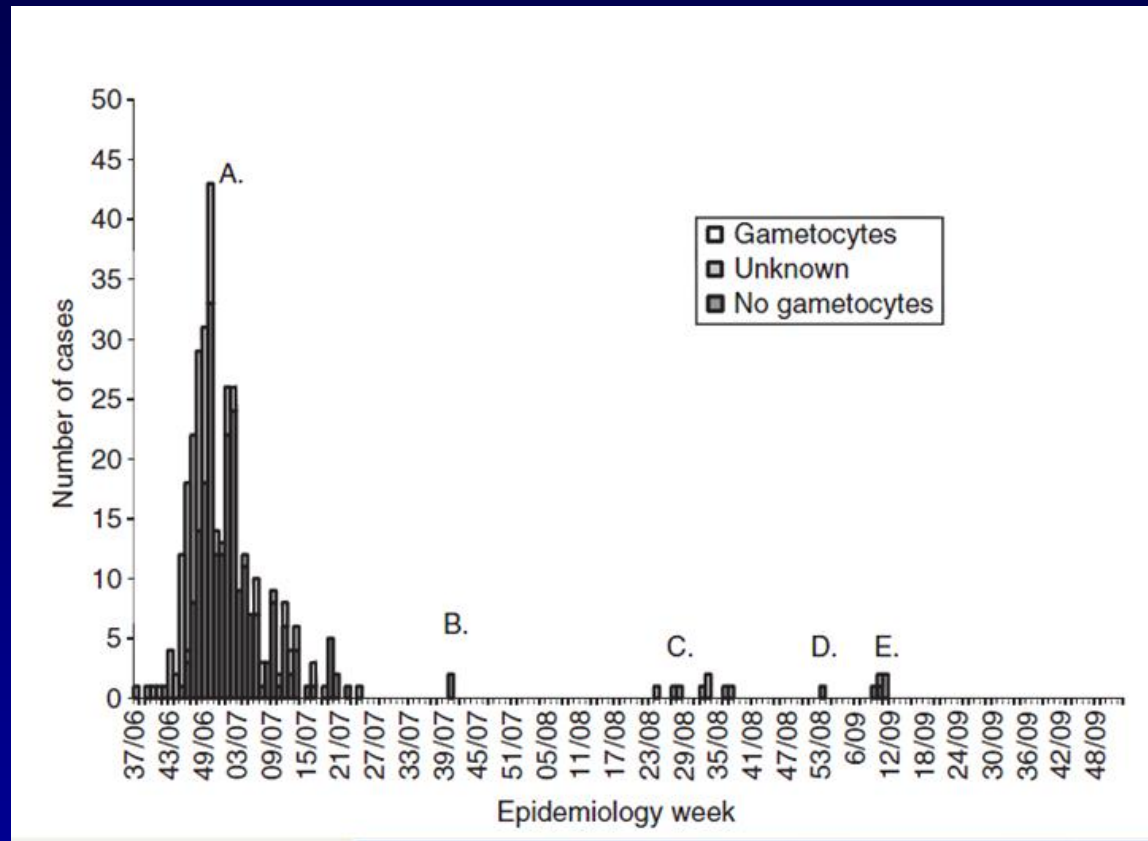
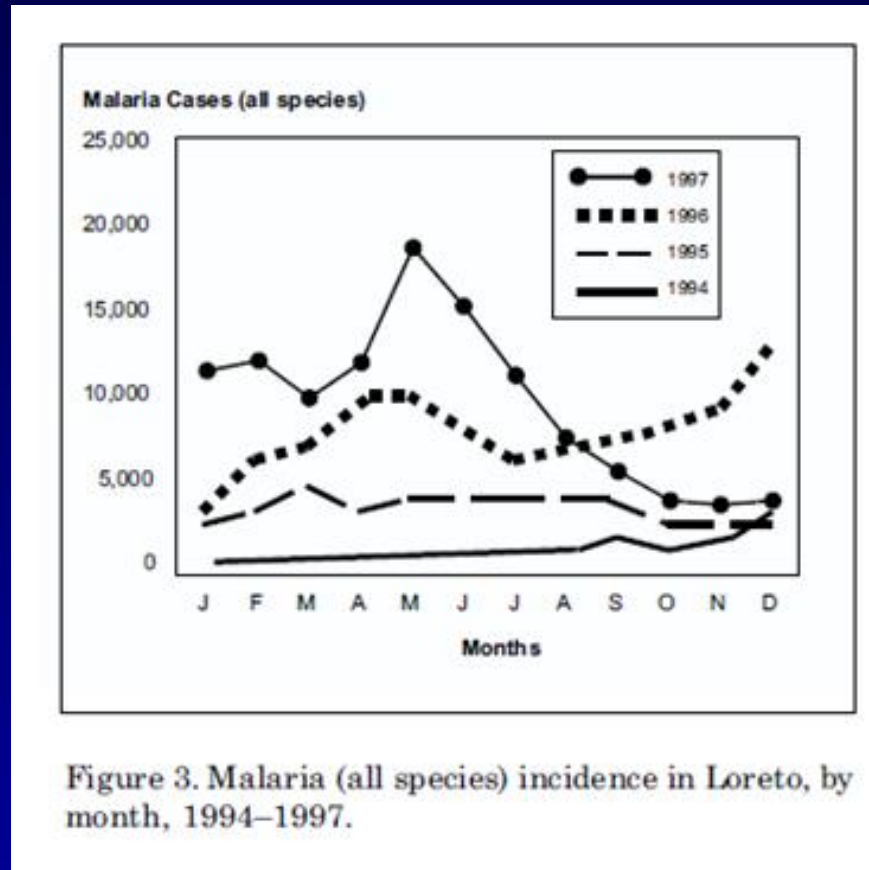


Figure. Confirmed cases of *P. falciparum* in Kingston and St. Andrew (KSA) by onset of symptoms on initial smear examination (n = 348). (Webster-Kerr, 2011)

Malaria in Jamaica, 2006–2009

- **Findings**
 - **Men and age 20–29 years**
 - **Multiple reintroductions by Haitians immigrants**
 - **Wide spread treatment of fever cases not universally recommended**
- **Lessons learned**
 - **Repeated reintroduction of parasites**
 - **Possible risk from neighboring areas and countries**

Malaria in Peru, Early 1990s



- *P. falciparum* (higher rate) and *P. vivax* from 1992 to 1997
- Aramburu et al, 1999

Malaria in Peru, Early 1990s

- Findings

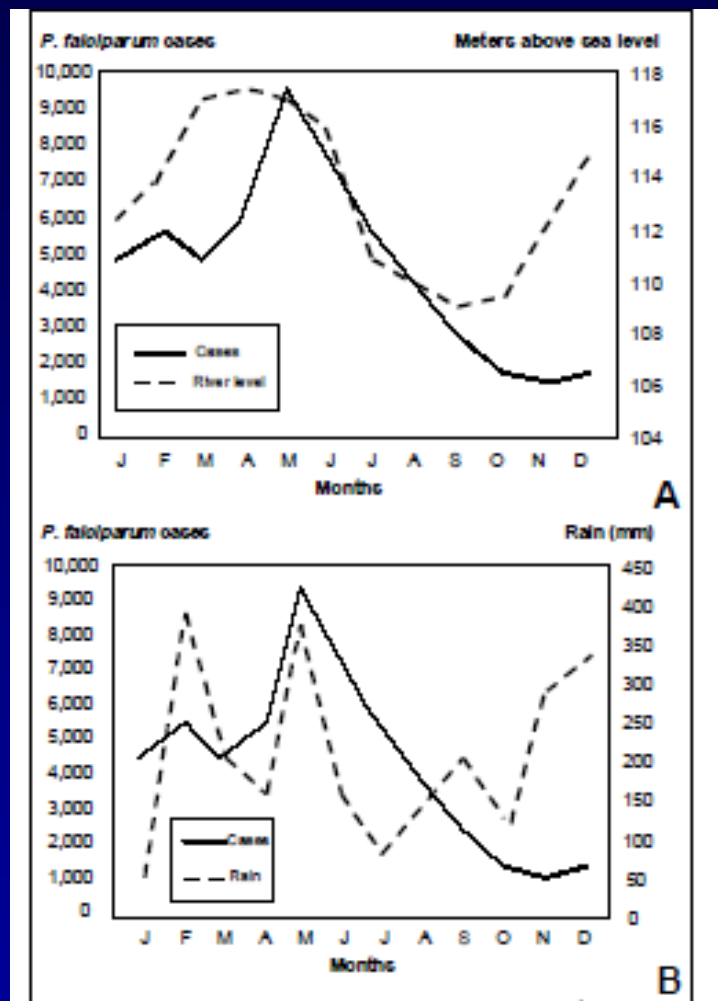
- Preceding *An. darlingi* increase

- Habitats

- Pools on cleared land, fish hatcheries, swamps, poor sanitation, small rivers

- Other species (*An. benarrochi* and *An. triannulatus*)

Malaria in Peru, Early 1990s



- Figure. *P. falciparum* incidence in Loreto by river level and rain fall, 1997.

Malaria in Peru, Early 1990s

- **Lessons learned**
 - **Climate changes and vector density as risk factors**
 - **Long-lasting consequence**

Malaria in Great Exuma, 2006

- Findings

- 4 cases in international travelers and 15 cases in Bahamians
- Haitians immigrants as potential source
- *An. albimanus* breeding sites
- Intensive vector control (larviciding)
- No more cases after Sept 19, 2006

Malaria in Great Exuma, 2006

- **Lessons learned**
 - **Prompt reporting and response**
 - **Aggressive control measures**
 - **Effective due to the limited nature of island**

Conditions for Transmission in the Americas

- **Malaria parasite**
 - Persons with gametocytes
 - Neighbors and travelers
- **Mosquitoes**
 - Breeding sites
 - Appropriate climate conditions

Conditions for Transmission in the Americas

- **Competent vectors still present**
- **Changing climate**
- **Presence of breeding sites**
- **Opportunities for people move around**

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Universidad del Valle Guatemala

- **Norma Padilla**

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