Acknowledging the Plague as a threat to American schools – suggestions for school IPM programs

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The Black Death (Great Pestilence or Great Mortality)
Title - “Ring Around the Rosie: Environmental Study on the Bubonic Plague”

The goal of this course is to associate environmental factors with specific human impact

Skill Development - Understand the basics of human infectious disease, Environmental health, Epidemiology, Vector borne disease

Objectives
Understand how ecological concepts can be used to manage environmental/health problems
Elementary applied ecology
Entomology and integrated pest management (IPM)
Global Climate Change
Bioterrorism

Understand the sociological/historical underpinnings of the Plague in England
History of the plague
Impacts of the plague on culture – religion, economics, art, etc.

Risk Communication Objectives
Describe how the principles of risk communication were derived from risk-perception research.
Explain why fears of some risks are amplified while other fears are assuaged.

REQUIRED TEXT:
Rats – Observations on the History & Habitat of the City’s Most Unwanted Inhabitants
On-line CDC modules for Vector Borne Disease Management
Assigned Readings
Assigned viewing – “Spillover: Zika, Ebola and Beyond”
Historians think that the plague arrived in England during the summer of 1348

- It is widely believed that Bristol (an important port city) was the place where the Black Death first reached England
- By 1st November the plague had reached London
- By 1350 nearly the whole of Britain was infected with the plague
Between 1348 and 1350, the plague killed nearly two and a half million people – 30-40% of England’s population.

- England’s estimated total population in 1350 is between 5 and 6 million.

- The plague kills an estimated 25 million people throughout Europe.
Where did the Black Death Come From?
The primary culprits in transmitting this disease were Oriental Rat Fleas carried on the back of black rats.
- Pneumonic plague was transmitted by airborne droplets.
- Although a flea cannot fly it can jump up to 200 times its own body length and 130 times its own height.
People were scared because they didn’t know what caused the plague

- A punishment from God
- Foreigners poisoning the wells
- Bad air
- Positions of the planets
Attempts to Avoid the Plague:

1. Avoid breathing the same air as a plague victim
2. Sit next to a blazing hot fire (it worked for the Pope in the summer of 1348)
3. Live in a house sheltered from the wind and keep the windows closed
4. Attack foreigners and people of different religions (20,000 Jews were burned to death in Strasbourg in 1348)
5. Letter from King Edward III to the Mayor of London (1349):
   ‘You are to make sure that all the human excrement and other filth lying in the street of the city is removed. You are to cause the city to be cleaned from all bad smells so that no more people will die from such smells.’
6. Walk around breathing flowers, herbs or spices
7. Live as a hermit – eat and drink in moderation and see no one
8. Run away to the country
9. Pray for forgiveness
10. Go on a pilgrimage. Punish yourself in public by joining the flagellants
Flagellants were people who travelled around whipping each other

- Believed that the Black Death was God’s punishment
- Punished themselves in order to beg forgiveness
plague treatments

- Sweating
- Bloodletting
- Forced vomiting and urinating
- Pigeons
- cupping
Ring around the rosie
A pocketful of posies
Ashes, ashes
We all fall down!

- Dates back to around 1666
- Some believe that it makes reference to the 1665 plague epidemic
  - ‘Ring around the rosy’ might refer to the plague’s symptoms on the skin
  - ‘A pocketful of posies’ might refer to the herbs and flowers carried due to the belief that disease was transmitted by bad smells
  - ‘Ashes’ and ‘We all fall down’ might refer to death
    - This is sometimes replaced by ‘Atishoo’ – sneezing was also a symptom of the plague
More plague facts

- Great Pestilence or Great Mortality
- Alexandre Yersin 1894
- Halted 100 years’ War
- Shortage of labor
- Peasants’ Revolt 1381 -
- England on verge of major power and consolidated – why?
More plague facts

- New strain...more virulence? DNA
- Idea conditions – streets were narrow, flowing with sewage, houses over crowded and poorly ventilated
- Came in the fall
- 500 days
Plague was the catalyst for many public health concepts including quarantine and public health sanitation.
Plague: Epidemiological Aspects

World Distribution of Plague, 1998

- Regions where plague occurs in animals.
- Came into CA “China Towns” in the early 1900’s
- 17 Western States had plague positive mammals or fleas
- 11 states will human plague cases
- Highest incidence is 4-corners area of Southwest and Pacific Coast

Environmental factors
- Cool
- Arid …humid?
- Higher elevation
- Squalor!!!
- Commensal rodents

http://www.cdc.gov/plague/maps/index.html
Plague: Epidemiological Aspects

- movement is northward and upslope -

1947-1989

- Colorado
- Arizona
- New Mexico
- California
- Others

N = 327

1990-1999

- Colorado
- Arizona
- New Mexico
- California
- Others

N = 85

N = 327

N = 85
Plague Ecology in the United States

Plague in Nature

Plague occurs naturally in the western U.S., especially in the semi-arid grasslands and scrub woodlands of the southwestern states of Arizona, Colorado, New Mexico and Utah.

The plague bacterium (Yersinia pestis) is transmitted by fleas and cycles naturally among wild rodents, including rock squirrels, ground squirrels, prairie dogs and wood rats.

Plague in Humans

Occasionally, infections among rodents increase dramatically, causing an outbreak, or epizootic. During plague epizootics, many rodents die, causing hungry fleas to seek other sources of blood. Studies suggest that epizootics in the southwestern U.S. are more likely during cooler summers that follow wet winters.

Humans and domestic animals that are bitten by fleas from dead animals are at risk for contracting plague, especially during an epizootic. Cats usually become very ill from plague and can directly infect humans when they cough infectious droplets into the air. Dogs are less likely to be ill, but they can still bring plague-infected fleas into the home. In addition to flea bites, people can be exposed while handling skins or flesh of infected animals.
Most important reservoirs are the various ground squirrels, commensal rats (*Rattus rattus* and *Rattus norvegicus*), and woodrats.

Plague is found in many parts of the world and hundreds of species of rodents (and rabbits) are susceptible.

The primary vector is fleas, of which many species can transmit plague. *Xenopsylla cheopis* and *Xenopsylla brasiliensis* are the most important species worldwide.
Prairie dogs can present unique dangers because of their close proximity to human populations.

14% of all human plague cases in the U.S. since 1959 were associated with prairie dogs.
Distribution of House Mice, Norway Rats, and Roof Rats

- **House Mouse**
- **Norway Rat**
- **Roof Rat**
Plague Cases by Elevation

Arizona, Colorado and New Mexico

1949-2000
In 2002, a couple contracted plague in New Mexico, traveled to New York City during the incubation period, then presented at a NYC hospital with plague. BT alarms? You bet!

Summer 2017 – three people hospitalized with the plague in New Mexico
In 1994 a plague outbreak in India created an international panic.

WHO invoked an international travel quarantine.

Economic losses topped $3 billion to India.

More than 5,000 cases reported in 1 month (questionable).
2000-2010, most world-wide cases have occurred in Uganda, Zambia, DRC, Tanzania and Madagascar.

CDC currently operates a plague field station in Uganda and has rendered assistance in Zambia, Tanzania and Madagascar.
Tree squirrel epizootics have occurred in Colorado Springs, Denver, and Fort Collins. Because *O. howardii* rarely feeds on people, human cases are rarely associated with these epizootics. (2 cases with 1 death, both involved the carcass)
Suggested school plague options

- Follow CDC guidelines on epidemic/bio-terrorism regarding prep and intervention

- Conduct “in-field” school IPM audits in plague prone areas to develop REALISTIC factsheets, demos, etc.

- Integrate with new EPA VBD workgroup/CoE??

- Pay attention to plague prediction work by Gage, et. al.

- Network with GCC & VBN scientists who are allowed to work (acknowledge?) GCC with particular attention to displacement of common fleas (cat, dog, etc.) with the Oriental Rat Flea AND new relationships with hosts (ex/ Groundhogs) ...both of which could allow for epidemics outside the West
Environmental Interventions

- Risk assessments based on all environmental aspects
- Surveillance of vectors, reservoirs, hosts
- Emergency control of vectors, reservoirs, hosts
- Post-control monitoring/re-control as needed
- Long-term post-event surveillance and/or control
Know BEFORE you need it:

- Know local conditions, vectors, reservoirs
- Know high risk agents and their epidemiology in your location
- Know your capabilities and capacities (previous slide)
- Know your partners and how to contact them
- Know your area! Know your venues. Know your staff. Know your equipment.
- Make sure your leaders know YOU!
Environmental Interventions

- Risk assessments based on all environmental aspects
- Surveillance of vectors, reservoirs, hosts
- Emergency control of vectors, reservoirs, hosts
- Post-control monitoring/re-control as needed
- Long-term post-event surveillance and/or control
Environment should be changed to cause increased competition and predation.

Rats – Observations on the History & Habitat of the City’s Most Unwanted Inhabitants

Recent Trends in Plague Ecology – Gage & Kosoy

Desert gerbils signal plague: Rodent numbers could predict human disease. Helen Pearson

Plague appears two years after a rise in the gerbil population. © Science

ANYTHING Bobby Corrigan and/or Rusty Enscore say or write about rodents and the plague!!!!