

Case Study Title: Emerging Infectious Diseases

Article Information:

Two reports sound the alarm on animal-borne diseases

Elizabeth Weise

USA TODAY July 19, 2005

Life

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Nation unready for germ attacks

Mimi Hall

USA TODAY August 1, 2005

News

USA TODAY p. 1A

Bird flu: How worried should you be?

Steve Sternberg

USA Today October 11, 2005

News

USA TODAY p. 1A

Antiseptic soaps bubble up again

Rita Rubin

USA TODAY October 20, 2005

Life

USA TODAY p. 8D

'Natural' chickens take flight

Elizabeth Weise

USA TODAY January 24, 2006

Life

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Summary Statement: Microbes are microscopic, living organisms. They include bacteria, viruses, fungi, and protozoa. The notion that all bacteria must be killed has become a pop culture phenomenon. In the 1990s, products from hand cleaners to air deodorizers that killed bacteria appeared. By the start of the 21st century, these antimicrobial products became ubiquitous in stores.

There are a variety of microbes on and inside our bodies that not only do us no harm, many actually benefit us. Some microorganisms protect us against disease by preventing growth of pathogens (disease-causing microbes). Other microbes produce useful substances such as vitamin K and B vitamins. However, a few microbes, called pathogens, do grow in humans and cause diseases called infections.

Until 1935, diphtheria was the leading infectious killer of children in the U.S. As a result of vaccination, fewer than five diphtheria cases occur annually. In the 1940s, when penicillin and streptomycin cured pneumonia, scientists predicted the end of infectious diseases. Since 1950, sewage and water treatment decreased typhoid fever cases more than 75%.

However, recent reports in USA TODAY point to the fact that infectious diseases are not disappearing, in fact, they seem to be emerging. The Centers for Disease Control and Prevention (CDC) defines emerging diseases as those that are new or increasing. Infectious diseases remain the leading cause of death worldwide. In 2005, infectious diseases killed about one third of the more than 52 million people who died worldwide. The CDC reports that 160,000 Americans die annually from infectious disease.

A variety of factors contribute to the emergence of infectious diseases including:

- (1) Genetic mutations. Scarlet fever was pandemic between 1830 and 1880, killing more children than measles, diphtheria, or whooping cough. About 1880, scarlet fever declined steadily. Today it is a relatively mild and rare disease. The most likely explanation offered for the pandemic of the 1800s and its decline is spontaneous mutations in the *Streptococcus pyogenes* bacteria that cause scarlet fever.
- (2) Natural disasters. Melioidosis increased following the 2004 Asian Tsunami when soil bacteria were disturbed.
- (3) Genetic recombination. In the 1970s, the common intestinal bacteria, *E. coli*, acquired a toxin gene from the pathogenic *Shigella* bacteria, and the ability to cause human disease.
- (4) Bioterrorism. The use of the U.S. Postal Service to spread the anthrax bacterium in 2001 demonstrated that the use of a pathogen to intimidate a group could introduce disease.
- (5) Spread of animal pathogens to humans. Recent genetic analysis shows that the 1918 influenza virus originated from genetic changes in a bird virus.
- (6) Migration. Migrating birds probably brought West Nile virus to the U.S.
- (7) Encroachment. Lyme disease is transmitted to humans who encounter ticks while venturing into wild areas.
- (8) Antibiotic abuse. Hospital-acquired infections have increased due to emerging antibiotic-resistant microbes. Misuse of antibacterial agents including antibiotics allows the growth of resistant bacteria. Misuse includes antibiotics prescribed for colds, patients who don't complete the full prescription or use leftover antibiotics prescribed for a different illness, and veterinary use of human antibiotics.

Discussion Questions:

- Travel to developing or underdeveloped countries involves exposure to infectious diseases. What general precautions should you take before visiting such a country? During your visit?
- Marburg hemorrhagic fever (MHF) is a severe and highly fatal disease caused by a virus from the same family (Filiviridae) as the Ebola virus. The first cases were identified in 1967 in Europe among laboratory workers handling African green monkeys imported from Uganda. Five outbreaks have occurred since then (see the table).

Year	Cases	Deaths	Country	Situation
1975	3	1	South Africa	Two travelers to Zimbabwe and a hospital nurse.
1980	2	1	Kenya	Patients visited Kitum Cave in Kenya's Mount Elgon National Park.
1987	1	1	Kenya	Patient visited Kitum Cave in Kenya's Mount Elgon National Park.
1998	154	128	Congo	Workers at a gold mine in Durba, Congo.
2005	313	280	Angola	Probably began in Uige Province, Angola.

- As an expert with the Global Outbreak Alert and Response Network, what measures would you use to control a Marburg outbreak?
 - Describe how the Marburg virus could get to the U.S.
 - Do you think an MHF epidemic could occur in the U.S.? Briefly explain.
- Diseases often emerge when some significant change in human behavior occurs. For each of the following diseases, identify one significant human behavior that contributed to the emergence or spread of the disease.
 - bubonic plague in the 1300s
 - smallpox in the 17th and 18th centuries
 - cholera in the 1800s
 - 1918 influenza pandemic
 - polio in the 1940s-1950s
 - Mark and Andrea were delighted that the U.S. Department of Agriculture Inspector didn't see the little plants they were bringing home from their trip to Mexico. Now they will be able to grow the plants and enjoy the fragrant flowers and sweet fruit in their own backyard. Hundreds of otherwise law-abiding American tourists try to "smuggle" contraband plants and fruits as souvenirs of their vacations. Discuss the dangers of this. How would you educate these travelers?
 - Discuss how each of the following can contribute to the emergence of infectious disease. What can be done to mitigate the impact of each of these?
 - misuse of antibiotics
 - regular household use of antibacterial cleaners
 - people going to uninhabited areas (e.g., clearing a rain forest; building a new subdivision)
 - genetic mutations or recombination of genes

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Future Implications: The threat of emerging infectious diseases will always be present. Increasing globalization and modern transportation can spread infection faster than anytime in history. It took tuberculosis 600 years to spread around the world. By contrast, AIDS took only 20 years to infect nearly 100 million people worldwide.

Microbes, including pathogens, will always be present, and no one knows what new diseases will emerge. The public health system must be prepared for the unexpected and individuals must join in the effort to prevent the spread of emergent infections.

To meet their responsibilities, people must be mindful that:

- Immunity wanes without contact with the pathogen or a booster vaccine. Only 20% of the adult population has effective immunity against diphtheria. As an example of what might occur if immunization programs are not maintained, waning levels of immunity in the countries of the former Soviet Union led to a diphtheria epidemic in the 1990s.
- Antimicrobials (antibiotics and household disinfectant) must be used properly to limit growth of resistant bacteria.
- Foods must be cooked and stored properly.
- Contact with wild animals should be minimized.
- According to the CDC, handwashing is the most important factor to prevent infection.

Additional Resources:

Barry, John. *The Great Influenza: The epic story of the deadliest plague in history*. New York: Penguin Books, 2004

Centers for Disease Control and Prevention. The Centers for Disease Control and Prevention is the branch of the U.S. Public Health Service responsible for developing and applying disease prevention and control, and health education in the U.S. “Traveler’s Health” covers information on travel destinations, vaccinations, safe food and water, and illnesses abroad. “Emergency Preparedness & Response” includes bioterrorism: biological agents, recent incidents, and preparedness plans. *Emerging Infectious Diseases* is a monthly, online journal. <<http://www.cdc.gov>>

Garrett, Laurie. *The Coming Plague: Newly emerging diseases in a world out of balance*. New York: Penguin Books, 1994.

McCormick, Joseph and Susan Fisher-Hoch. *Virus Hunters of the CDC*. Atlanta, GA: Turner Publishing, 1996.

Stolley, Paul and Tamar Lasky. *Investigating Disease Patterns: The science of epidemiology*. New York: Scientific American Library (Freeman and Co.), 1995.

World Health Organization. The World Health Organization is the United Nations agency for health. The website includes current status reports of emerging diseases by country. “Featured archives” include news reports. <<http://www.who.int/en/>>