

Biological Hazards including Bio-Terrorism

Key Points

- Throughout history disease outbreaks have changed and shaped society. The impact of these diseases varies based on the virulence of the disease, duration of the illness and spread within the community.
- The most threatening emergency management situation is the outbreak of a new disease with high rates of morbidity (illness) and mortality (death). New disease outbreaks can quickly overwhelm local hospitals, healthcare providers and decrease society's ability to maintain critical services.
- An outbreak can be characterized by the extent of spread of the disease. An outbreak is considered a pandemic if the disease spreads throughout the world. The outbreak is considered an epidemic if it is above normal disease levels within a geographical area. More common diseases are classified as endemic, as they are at or below normal levels within a community. Brand new diseases can quickly become an epidemic/pandemic if there is little or no immunity in the population.
- Common disease outbreaks include influenza, Pertussis, hepatitis, Salmonella, E. coli and Tuberculosis. New strains of influenza are a great risk to King County, due to the low immunity in the community, the potential for severe symptoms, and the speed at which the virus can spread from person to person. It is estimated that a severe pandemic influenza could cause illness in 540,000 people and over 11,000 deaths in King County.
- For King County, the Communicable Disease Epidemiology & Immunization Section within Public Health – Seattle & King County investigates and coordinates the Public Health surveillance of disease outbreaks.

Context

Disease has been one of the most influential factors in human history. On many occasions disease has shaped civilizations and altered the course of history. Throughout the 20th century great strides in medicine have produced many treatments and cures for the most deadly diseases. Many of these medical advances have given us a false sense of security that all diseases can be treated or cured in a timely manner, even though the potential for a devastating disease outbreak continues to threaten our community.

The impact of a disease can be tracked and characterized using several different indicators. These indicators can help Public Health assess and respond to potential disease outbreaks.

Virulence: The ability of a pathogen to cause disease.

Severity: The seriousness of the effects of the disease.

Duration: The symptoms of a disease can either be acute or chronic. Acute diseases have a rapid onset causing severe disease (e.g., influenza, Salmonella, Pertussis). Chronic disease persists for a longer period of time (e.g., heart disease, diabetes, cancer).

Scale: The scale of the disease is described by the extent of the spread of disease in the community. An outbreak can be classified as an endemic, an epidemic, or a pandemic depending on the prevalence of the disease locally and around the world.

Some diseases, such as Salmonella and E. coli, can be spread quickly through food and water sources. Though these diseases are treatable they can lead to severe symptoms or death if not addressed quickly.

Although chronic disease has placed a lasting strain on the healthcare system, acute disease is a greater immediate threat to the system's capacity. Acute disease outbreak has the potential to paralyze critical operations.

West Nile virus is an emerging pandemic that has affected numerous communities across the country. West Nile is transmitted through mosquito bite only and can be spread to humans, horses, and birds, causing severe symptoms or death.

Many potentially devastating diseases are spread through physical contact, ingestion, insects and inhalation. Airborne diseases and those spread through physical contact pose higher risks to the community because they are difficult to control. Diseases such as influenza, Pertussis, Tuberculosis, and meningitis are all spread through these methods and pose a significant threat to our community.

History

Throughout the 20th century several epidemics and pandemics have occurred in our community.

Influenza. 1918-1919: The influenza pandemic of 1918 was especially virulent, killing a large number of young, otherwise healthy adults. The pandemic caused more than 500,000 deaths in the United States and more than 40 million deaths around the world. The 1918 pandemic first arrived in Seattle in October 1918; over the next six months the virus claimed 1,600 lives.

Influenza. 1957-1958: The influenza pandemic of 1957 was less severe than the 1918 pandemic, and caused a total of 70,000 fatalities nation-wide.

Influenza. 1968-1969: The influenza pandemic caused more than 34,000 deaths in the U.S. and cause severe morbidity and mortality around the world.

E.coli. 1993: E.coli-contaminated hamburger meat from a local Jack in the Box caused illness in 400 people and led to the death of two people within one month in the Washington area. Cases were seen in California, Idaho, and Nevada as well.

Pertussis. 2002-2005: Between 2002 and 2003 Public Health reported an 82% increase in the number of Pertussis infections in infants, and a three-fold increase in the number of cases in children <6 months. The occurrence of Pertussis in adolescents and adults has been on the rise since 1990, culminating in a national epidemic in 2005 when 25,616 reported cases nation-wide. Outbreaks within healthcare facilities can occur quickly because the bacterial infection is highly contagious.

Influenza. 2009: Like the 1918 pandemic, the H1N1 outbreak of 2009 affected the young and health populations as well as those with chronic diseases. This increase in morbidity caused strain on the local healthcare system. Although there were not nearly as many fatalities as previous pandemics, the outbreak caused a larger than usual amount of disease in the community.

Likelihood of Future Occurrence

Although it is impossible to predict the next disease outbreak, history has shown that outbreaks are not uncommon and can produce devastating effects on a community. While the revolution in medicine in the past century has increased our ability to counteract disease, increases in the number of people

without adequate healthcare, the evolution of antibiotic resistant bacteria and globalization help make outbreaks spread more quickly and increase their severity. Disease outbreaks not only cause increased morbidity and mortality in the community, but also put a greater strain on the healthcare and infrastructure system that could prevent the operation of critical services.

Vulnerability

In many epidemic and pandemic situations, disease spreads quickly throughout a community. There are many factors that can increase Seattle's vulnerability to disease spread. Since many of the potential disease outbreaks involve close contact or inhalation of the pathogen, locations where large numbers of people gather in a close environment are perfect circumstances to spread disease. Seattle has the largest population density in Washington, over 7,000 people per square mile. The city is also a transportation hub with SeaTac airport to the south and numerous railway and bus stations. Many large social events routinely occur in the city including sporting events, parades, and concerts.

Disease often affects those most vulnerable in our communities. Young children, the elderly, the poor and those with underlying health conditions are often the hardest hit by disease.

Seattle has a large concentration of healthcare resources, but in an epidemic or pandemic these resources can be stretched or overwhelmed by the outbreak situation. The Seattle area also provides specialized medical care for a large geographic area, including one of the areas pediatric hospitals and the only Level 1 Trauma center for Washington, Idaho, Montana, and Alaska. In addition, Airlift Northwest located at Boeing Field is the only life-flight agency serving the same four-state region.

Other resources, such as food and water, are also a concern when planning for disease outbreaks. Seattle has many open reservoirs that provide water to the city. These reservoirs can be vulnerable to contamination and disease spread. Food sources can become quickly contaminated from improper handling and cooking methods. Continual surveillance is done by Public Health to protect against widespread food-borne illness outbreaks. Assessment

Seattle will surely be struck by epidemics and pandemics. The question is how severe these outbreaks will be. Communicable diseases impose a cumulative burden on the community, but significant outbreaks bear additional costs.

Consequences

Epidemics directly affect the health of people who live, work and visit a community. They have the potential to be one of the deadliest hazards a community can face. Sickness is the most visible consequence of an epidemic, but they can severely affect the community as schools, businesses, government agencies and non-profit organizations curtail operations due to employee illness or as countermeasures. The effects of these curtailments grow the longer the disease persists.

Epidemics are not uncommon in King County. Seattle / King County Public Health monitors dozens of communicable diseases. Some of these, like seasonal flu, infect many people but most cases are mild. Other epidemics, like whooping cough, are very severe but infect only a small segment of the population. These epidemics are handled within the normal health care system.

The most likely scenario that activates the City's emergency management system would be a disease outbreak that just exceeds our public health system's capacity and has many indirect socio-economic effects like the need to close schools or businesses. We have chosen a listeriosis outbreak for the Most Likely Scenario. It occurs in small numbers each year in King County but more widespread outbreaks

occur regularly. It is one of the deadliest food borne pathogens and one of the hardest to investigate because it can be dormant for a while before it makes a person sickⁱ. A large outbreak centered in Seattle would cause a strain on the public health system and potentially have strong impacts on local businesses, especially any that the public perceives as responsible for the outbreak.

The most severe disease outbreaks would involve pathogens that would infect a large percentage of an exposed population and kill large numbers of them. Pandemic influenza is the disease most likely to cause this great a disaster. It poses a great threat to health of our local community as well as the national/international community. Beyond the human morbidity and mortality pandemic influenza can have many socio-economic consequences. Cancellations of schools, work and public gatherings may be enacted to attempt to halt the spread of disease. Staff absenteeism can create a strain on government and healthcare systems causing limitations of services and care. The 2009 H1N1 flu outbreak showed how potentially easy it is to overwhelm the healthcare system, even though, as it happened, H1N1 was an influenza that caused less disease than a typical seasonal flu. A pandemic influenza that caused moderate or severe disease would have a much larger impact on the community. The following table outlines expected disease rates based on Center for Disease Control modeling.

Table 1. Estimated number of Episodes of Illness, Healthcare Utilization, and Deaths Associated with Moderate and Severe Pandemic Influenza Scenarios for the US Population and King County.

Characteristic	Moderate (1958/68 - like)		Severe (1918 - like)	
	US	King County	US	King county
Illness	90 million	540,000	90 million	540,000
Outpatient Care	45 million	270,000	45 million	270,000
ICU Care	128,750	733	1,485,000	8,910
Mechanical Ventilation	64,875	389	742,500	4,455
Deaths	209,000	1,254	1,903,000	11,418

Source: Public Health - Seattle & King County. (2008). *PANDEMIC INFLUENZA RESPONSE PLAN*ⁱⁱ.

Bioterrorism is another potential cause of on a catastrophic disease outbreak. This scenario is included as the maximum credible scenario under terrorism.

Most Likely Scenario

Seattle is the center of a severe listeriosis outbreak that kills 10 people and makes hundreds severely ill. The emergency is complicated because public health officials have a difficult time isolating the cause of the emergency. Public Health officials must use available resources to address the need.

Category	Impacts 1 = low 5 = high	Narrative
Frequency	4	Seattle has experienced disease outbreaks many times in its history. Six events stand out for their complexity and severity: influenza in 1918, 1957, 1968 and 2009; E. Coli in 1993; and Pertussis from 2002 to 2005. The scenario here envisions a food borne illness that is similar but more complex and severe that the 1993 event.
Geographic Scope	5	The disease strikes the entire Central Puget Sound region.
Duration	5	It takes health officials two months to contain the illness and for patients to recover.

Category	Impacts 1 = low 5 = high	Narrative
Health Effects, Deaths and Injuries	4	Ten people die but 11,456 become ill and 1833 need to be hospitalized.
Displaced Households and Suffering	1	No families are physically displaced from their homes, but 5 schools are closed for a week and major events are cancelled.
Economy	2	Restaurants, stores and other places suspected or later found to have sold contaminated food suffer sales losses, but the wider City economy is able to absorb the losses.
Environment	1	The environment is not directly affected by this event.
Structures	1	Buildings are not affected by this event.
Transportation	1	The transportation system is not affected by this event.
Critical Services and Utilities	1	Critical services and utilities are not affected by this event.
Confidence in Government	1	The public health system is able to respond quickly to the event. The public's confidence in its public health system grows.
Cascading Effects	1	Affected institutions and businesses must deal with closures, cancellations, business loss and absent workers, but they are not concentrated so they do not cause ripple effects.

Maximum Credible Scenario

A severe pandemic flu sweeps the globe striking Seattle. Seattle has 3,600 deaths and 171,000 illnesses. The crisis lasts a month. Economic activity slows severely. Providers have difficulty maintaining service levels to vulnerable populations. Public health officials implement emergency plans to stand up alternate care facilities, deliver medication and handle remains respectfully.

Category	Impacts 1 = low 5 = high	Narrative
Frequency	3	This scenario is based on planning done by the Seattle / King County Public Health. It envisions an event similar to the 1918 pandemic influenza. It is estimated as a 100 year event.
Geographic Scope	5	The disease is world-wide. It moves quickly around the globe due to air travel. Surveillance systems detect the disease a week before it reaches Seattle. Emergency responders are able to do some planning.
Duration	5	The most acute part of the outbreak lasts four weeks in Western Washington but preparations for the arrival of the disease and recovery from it keeps the emergency management system busy for seven weeks.
Health Effects, Deaths and Injuries	5	The severe influenza has enormous consequences for Seattle public's health. 170,000 people in Seattle become ill. Half (85,000) need outpatient care. 3600 people die including many young adults. 2809 people require ICU care and 1404 require mechanical ventilation.

Category	Impacts 1 = low 5 = high	Narrative
Displaced Households and Suffering	5	Although no households are displaced due to physical damage to their home, nearly everyone in Seattle is directly affected. Schools are closed for weeks. So many people are sick or must care for children or sick people that many businesses and government offices close. The city faces critical shortages of supplies including food.
Economy	4	The economy comes to a standstill for weeks, but surges once the illness subsides. Unfortunately, that is too late for many small businesses that cannot withstand weeks of downtime.
Environment	1	The environment would not be directly affected, but would suffer indirect impacts due to staff shortages in agencies that oversee environmental protection and monitoring.
Structures	1	Although the disease does not destroy buildings, absenteeism affects how buildings run. The lack of support staff cause many buildings to close.
Transportation	3	The disease would not cause any direct damage to the transportation system, but high absenteeism would affect it. Public transit, shipping and infrastructure management operate at 50% capacity.
Critical Services and Utilities	3	Governments attempt to keep their public safety personnel healthy, but influenza affects service. Police, fire, and emergency medical services have to greatly reduce service levels. Water, power, wastewater and communications are able to continue operations with reduced staffing but are unable to respond to outages and other problems.
Confidence in Government	3	The public understands the influenza is a severe natural event. Restrictions on public gatherings are not popular and create frustration. Some people believe they are not getting enough attention from the medical community.
Cascading Effects	2	The disease does not directly cause secondary effects, but the staffing reductions makes the City harder to operate. Several non-life threatening landslides occur during this time, but the City is not able to respond due to staffing shortages.

Conclusions

Disease outbreaks can be severe and unpredictable. Many diseases can cause epidemics and pandemics such as influenza, Pertussis, hepatitis, Salmonella, E. coli, West Nile and Tuberculosis. Outbreaks can cause greatly increased levels of morbidity (illness) and mortality (death) within the community, in addition to overwhelming the healthcare system and disrupting essential community services through staff absenteeism. Public Health – Seattle & King County manages the ESF-8 Health, Medical, and Mortuary Response plan and is responsible for monitoring and responding to any potential disease outbreak.

ⁱ CDC, 2013

ⁱⁱ Estimates are based on extrapolation from past pandemics in the US, and do not include the potential impacts of interventions not available during the 20th Century pandemics. The calculations used to determine the figures in this table are based on the following assumptions:

- King County accounts for 0.6% of the total US population.

- Susceptibility to the pandemic influenza subtype will be universal.

- The clinical disease attack rate will be 30% in the overall population. Illness rates will be highest among school-aged children (about 40%) and decline with age. Among working adults, an average of 20% will become ill during a community outbreak. Of those who become ill with influenza, 50% will seek outpatient medical care.