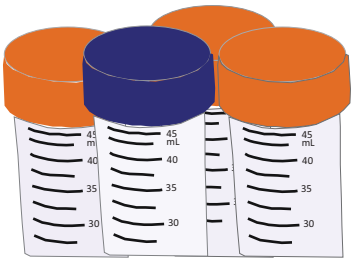


7. Disease Outbreaks

A. Hazard Profile

i. Hazard Description

A disease outbreak occurs when disease cases exceed what would normally be expected in a defined community, geographic area, or season. The spread, duration, and severity of outbreaks vary tremendously depending on the disease and other factors. There are several ways diseases can spread, including airborne transmission, direct contact, and indirect contact. Disease outbreaks can cause sudden, pervasive illness in all age groups, but they can disproportionately impact some populations that are more susceptible to an outbreak.

Traditionally, major disease outbreaks have been caused by bacterial or viral organisms. Improvements in sanitation in New York City have significantly reduced the likelihood of a bacterial outbreak, such as cholera or typhoid, although there are still periodic outbreaks of food-borne illnesses. In contrast, viral outbreaks are still a regular threat. Each year seasonal influenza outbreaks affect New York City. In addition, several global viral threats are being monitored by the New York City Department of Health and Mental Hygiene (DOHMH) for the potential to develop into pandemics that could spread to New York.

Disease outbreaks that could affect New York City include:

Pandemic and Severe Seasonal Influenza

Influenza pandemics occur when there is a significant genetic change in a circulating strain of influenza. Because people have not previously been exposed to this new strain, they do not possess immunity to it and are therefore susceptible to contracting the illness. The new strain of influenza can spread rapidly from person to person, with a large portion of the population vulnerable to infection.

Symptoms of influenza include fever, achiness, respiratory difficulties, and extreme fatigue, and for some people these symptoms can last up to two weeks. Transmission of the disease occurs when people come into contact with infected droplets expelled by coughing and sneezing or with contaminated materials and surfaces.

An influenza pandemic may be mild/moderate or severe. The pandemic of 1918 is the most recent example of a severe outbreak. Mild/moderate outbreaks occurred in 1957 to 1958, 1967 to 1968, and 2009.

Current influenza strains being monitored globally for pandemic potential include H5N1 and H7N9. However, the next pandemic strain might as yet be unidentified and remain so until an outbreak occurs, as was the case with H1N1 in 2009 and 2010.

Coronavirus

First identified in humans in the mid-1960s, coronaviruses are common viruses that most people get at some point in their lives. Transmission occurs when people come into contact with infected droplets expelled by coughing and sneezing or with contaminated materials and surfaces. Human coronaviruses usually cause mild to moderate upper-respiratory tract illnesses. However, occasional forms of coronavirus can cause very serious illness. In 2003, infection with the coronavirus known as Severe Acute Respiratory Syndrome (SARS-CoV) was characterized by high fever, headache, coughing, and breathing difficulties, and was in many patients severe or fatal. The most recently identified high-risk coronavirus is known as Middle Eastern Respiratory Syndrome (MERS-CoV) and is concentrated in Saudi Arabia as of the writing of this report, with some travel-associated cases outside of the Middle East.

Novel Viral Outbreak

Novel viral outbreaks occur when a previously unknown viral disease is identified. One example is West Nile virus, a mosquito-borne virus that appeared in 1999 and can cause serious health conditions including encephalitis and meningitis. West Nile is most prevalent during peak mosquito season, June 1 to October 31. The City closely monitors suspected cases of the disease in humans and has a vigorous prevention and response program.

Bacterial Outbreaks

In addition to naturally occurring disease outbreaks, there can be outbreaks caused by the use of biological agents by terrorists. For example, anthrax, caused by the bacterium Bacillus anthracis, is a disease commonly found in livestock, but the bacteria has been manufactured for use as a bioterror weapon. There are three types of anthrax: cutaneous, inhalation, and gastrointestinal. In New York City, infection might result from exposure to animal skins or wool, but the most likely exposure would come from the intentional release of spores through an act of bioterrorism.

As with anthrax, plague outbreaks can occur from either natural or intentional exposure. They are caused by the bacterium Yersinia pestis, usually found in rodent fleas. Humans can be naturally exposed when bitten by a rodent flea or when handling infected animals. There are three forms of plague: bubonic, septicemic, and pneumonic. Symptoms vary by form but include fever, chills, and headache, with a high rate of death in untreated patients. The intentional release of plague as an act of bioterrorism could lead to significant illness and mortality among New York City residents.

ii. Severity

The extent of an outbreak can be classified as endemic, epidemic, or pandemic. Endemic refers to the usual presence of a disease within a specific population or area. An epidemic is the sometimes-sudden increase in the number of cases of a disease that exceeds what is normally expected. A pandemic refers to an epidemic that has spread across the region and over several countries.

An outbreak's severity is not only dependent on disease characteristics but also on the availability of countermeasures. Pandemic influenza has two forms of pharmacologic countermeasures: antiviral medications for infected persons and vaccination to prevent infection in the first place. Coronaviruses, however, currently lack either vaccinations or frontline treatments. Strict enforcement of infection control, especially in healthcare or communal settings, is the primary method of outbreak prevention. Bacterial outbreaks like anthrax or plague are counteracted by antibacterial treatments.

iii. Probability

Although it is difficult to predict the next disease outbreak, history has shown that outbreaks are not uncommon. Influenza pandemics have occurred every 10 to 60 years, with three occurring in the 20th century (1918, 1957 to 1958, and 1967 to 1968) and one in the 21st century (2009 to 2010). Even though substantial improvements have been made in medicine over the past century, several factors increase the probability of future occurrences: population growth, increases of populations that do not have access to healthcare, evolution of antibiotic-resistant bacteria, and globalization.

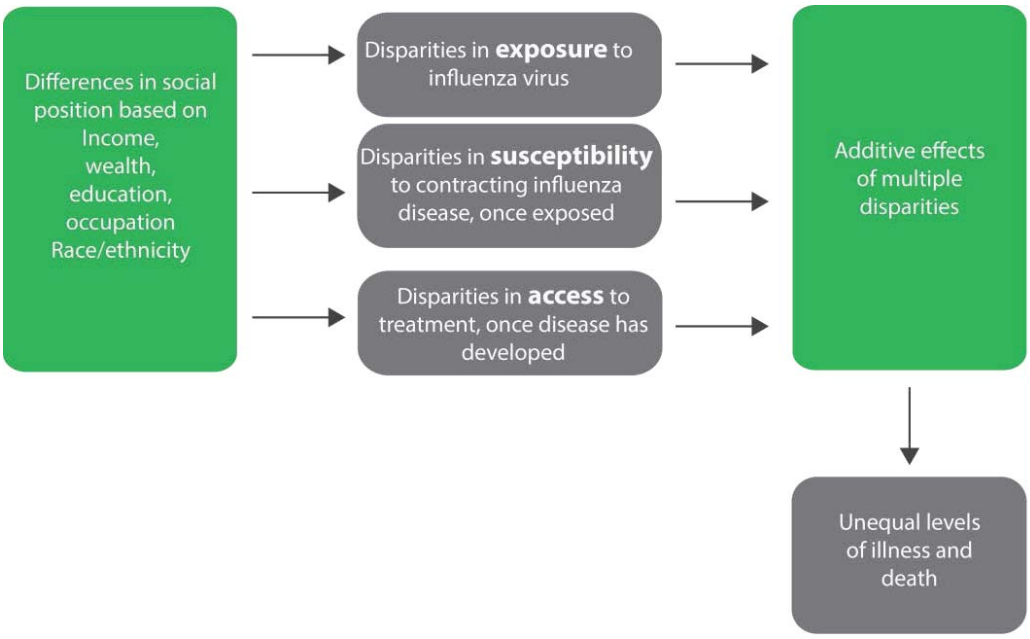
iv. Location

New York City is exceptionally vulnerable to disease outbreaks due to its dense population combined with the fact that it is a major port of entry. Airports, transit hubs, and mass transit can increase exposure to disease outbreaks because people from all over come into contact with each other in these locations. Whether natural or intentional, infectious disease outbreaks pose serious threats to the city and could strain the capacity of healthcare facilities to respond.

Based on a recent study conducted by DOHMH, some clusters of residents in the city may be more vulnerable to respiratory outbreaks such as pandemic influenza. For this study, DOHMH drew on Blumenshine's (2008) conceptual model of pandemic influenza vulnerability, which shows that increased exposure, increased susceptibility, and lack of access to care are all vulnerability indicators (see Figure 3.7.56). DOHMH generated individual-level vulnerability scores using micro data from the American Community Survey and the Behavior Risk Factor Surveillance System, and then mapped the overall density of those most vulnerable to a pandemic in New York City (see Figure 3.7.57).

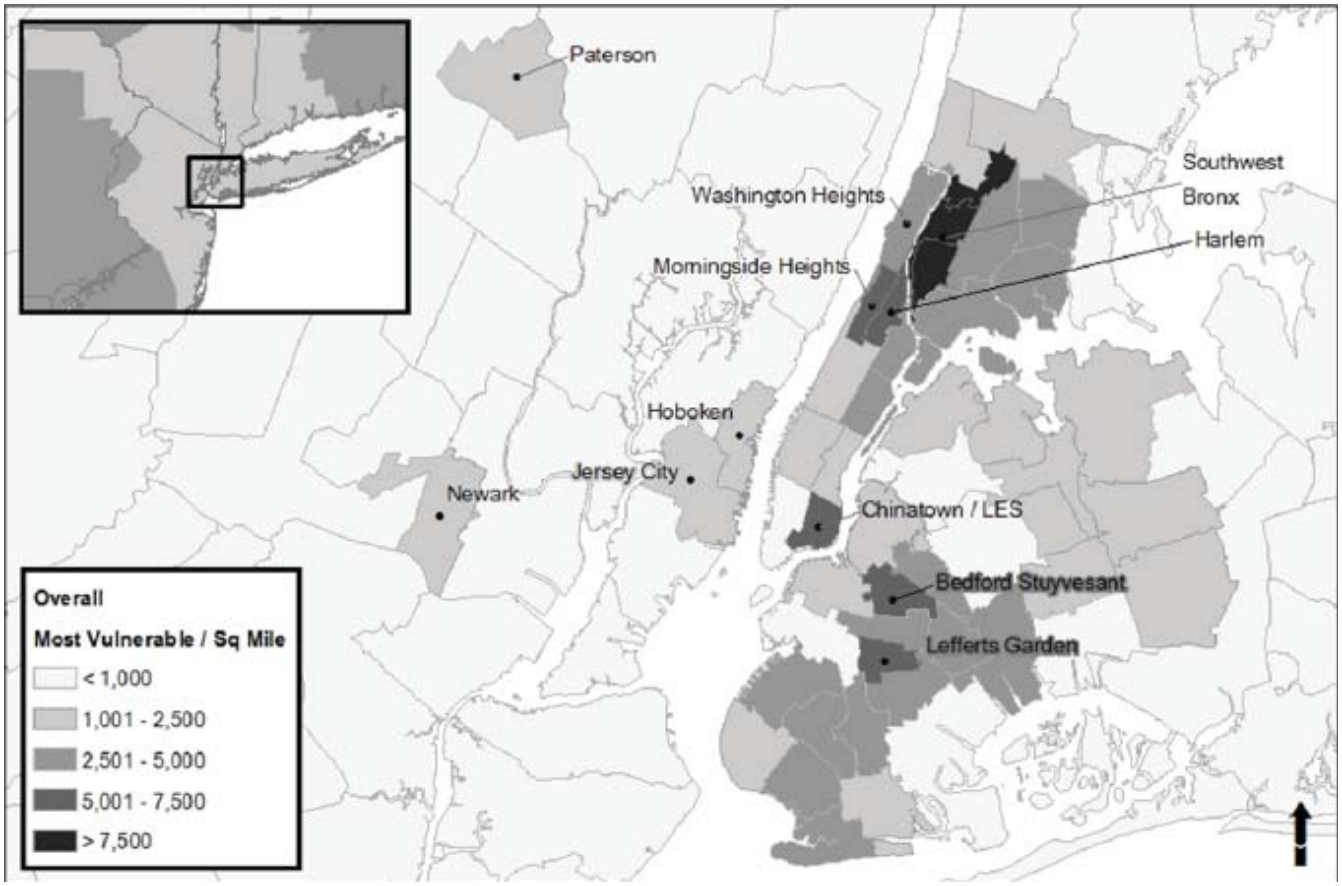
DOHMH identified three tiers of population clusters vulnerable to pandemic flu outbreaks. Concentrations of those most vulnerable to the spread of pandemic influenza (tier one) are highest in the southwest Bronx. The second tier of neighborhoods vulnerable to pandemic influenza outbreak includes Morningside Heights, Chinatown, Lower East Side, Lefferts Garden, and Bedford-Stuyvesant. The third tier of neighbor-

Figure 3.7.56: Conceptual Model of Vulnerability during an Influenza Pandemic



Source: Blumenshine et al. 2008: 709.

Figure 3.7.57: Density of Populations with Vulnerability to Influenza Pandemic



hoods vulnerable to the spread of pandemic influenza includes Harlem and Coney Island.

v. Historic Occurrences

Throughout New York City's history there have been disease outbreaks, beginning in 1668 with the first cases of yellow fever (see Table 3.7.34). In fact, outbreaks of yellow fever in the 1700s and 1800s led to the creation of the New York City Board of Health in 1805. As the city's water and sanitary conditions improved, disease outbreaks, especially bacterial, were reduced.

A more recent disease outbreak was the H1N1 influenza pandemic in 2009. First identified in Mexico in April 2009, it spread to New York City in late April, followed by a global pandemic that lasted through the spring and into early summer in New York City. DOHMH estimates that as many as one million New Yorkers were infected.

Table 3.7.34: Selected Disease Outbreaks in New York City 1668 to 2013

Year	Event	Description
1668	Yellow fever	• First yellow fever epidemic in New York City • Symptoms include yellowed complexions and vomitting black bile • Described as an "autumnal bilious fever in infectious form" • Governor Francis Lovelace of New York establishes "General Day of Humiliation" in response to the rapid spread of fever
1799	The Great Epidemic	• Major yellow fever epidemic • Kills 2,086 from late July to November
1805	Yellow fever	• Mayor De Witt Clinton establishes the New York City Board of Health in response to the outbreak • Board of Health orders evacuation of neighborhoods and collects mortality statistics
1819	Yellow fever	• Major epidemic • Board of Health evacuates impacted districts and creates barriers to neighborhoods that led to the initial spread
1832	Cholera	• Outbreak begins on June 26 • Disease peaks at 100 deaths per day by July • More than 3,500 deaths occur in the city • 80,000 people flee the city during the epidemic
1848 to 1849	Cholera	• Outbreak begins December 1848 and by June 1849 reaches epidemic level • Board of Health creates makeshift cholera hospitals and convinces police to remove thousands of hogs from crowded tenement areas
1866	Cholera	• Outbreak causes 1,137 deaths • Disease spread is limited by the Metropolitan Board of Health and the enforcement of sanitation laws
1900 to 1920	Tuberculosis	• In 1900, tuberculosis (TB) is the leading cause of death among adults in New York City • Department of Health (DOH) opens TB clinics • Death rates are reduced by half by 1920
1907 and 1915	Typhoid fever	• Mary Mallon, a cook nicknamed "Typhoid Mary," is deemed the carrier responsible for the spread of the disease • 53 cases and 3 fatalities in the city
1916	Polio	• Polio reaches epidemic proportions in the summer of 1916 • 8,991 cases and 2,448 deaths in the city

Year	Event	Description
1918	Spanish flu	• Spanish flu pandemic occurs worldwide • DOH staff diminished due to the entry of the United States into World War I—many doctors and nurses leave the city to join the Red Cross and Army Medical Corps • 12,000 New York City residents die from influenza-related causes
1957 to 1958	Asian flu	• 800,000 cases of Asian flu, representing • 10% of New York City's population
1968 to 1969	Hong Kong flu	• Mild flu pandemic results in 33,800 deaths in the United States • Virus is similar to 1957 Asian flu, which provides some immunity • Begins in December 1968 during school vacation, which may have limited the spread of the illness
1981 to present	AIDS (Acquired Immune Deficiency Syndrome)	• First 41 cases identified by the Center for Disease Control (CDC) in 1981 • By 1983, health officials learn that the disease is spread by sexual contact or sharing hypodermic needles • DOH creates initiatives to limit access to hypodermic needles • By 1986 DOH launches major prevention and treatment programs • In the 1990s, DOHMH provides access to potent antiretroviral therapies, leading to a significant drop in the city's AIDS-related deaths
1999	West Nile virus	• Mosquito-borne virus • 62 cases and seven fatalies
2001	Anthrax	• The nation's first anthrax case is in New York City • 8 people infected, including the child of a media employee
2009 to 2010	H1N1	• DOHMH estimates that as many as one million New York City residents were infected

B. Vulnerability Assessment

i. Social Environment

Disease outbreaks affect the population in many ways, and some groups may be more vulnerable than others. An examination of the spread of pandemic influenza illustrates this phenomenon. Blumenshine's conceptual model of pandemic influenza vulnerability identifies mechanisms by which income, race, and other social attributes influence exposure, susceptibility, and access to treatment during an outbreak. DOHMH's vulnerability study builds on this model, determining 10 causes of vulnerability (see Figure 3.7.58).

Exposure

Transmission of pandemic flu is typically airborne, but pandemic flu can also spread through direct and indirect contact. Low-income populations may be more vulnerable to outbreaks than others. They are more likely to have crowded living conditions and workplaces, and they are also more likely to depend on public transportation—all factors that inhibit their ability to distance themselves from others and thus increase their chance of exposure. Since frequent contact with infected populations increases the risk of exposure, healthcare providers, care givers, and first responders are also vulnerable.

Susceptibility

Certain populations are more susceptible to contracting pandemic flu. These populations include the very old, the very young, and people with pre-existing conditions such as diabetes, cardiovascular disease, or HIV. Stress levels, environmental conditions, and social behavior also play an important role. For example, high-stress work situations, poor or unsafe housing, or drug addiction and alcoholism can increase the likelihood and severity of infection.

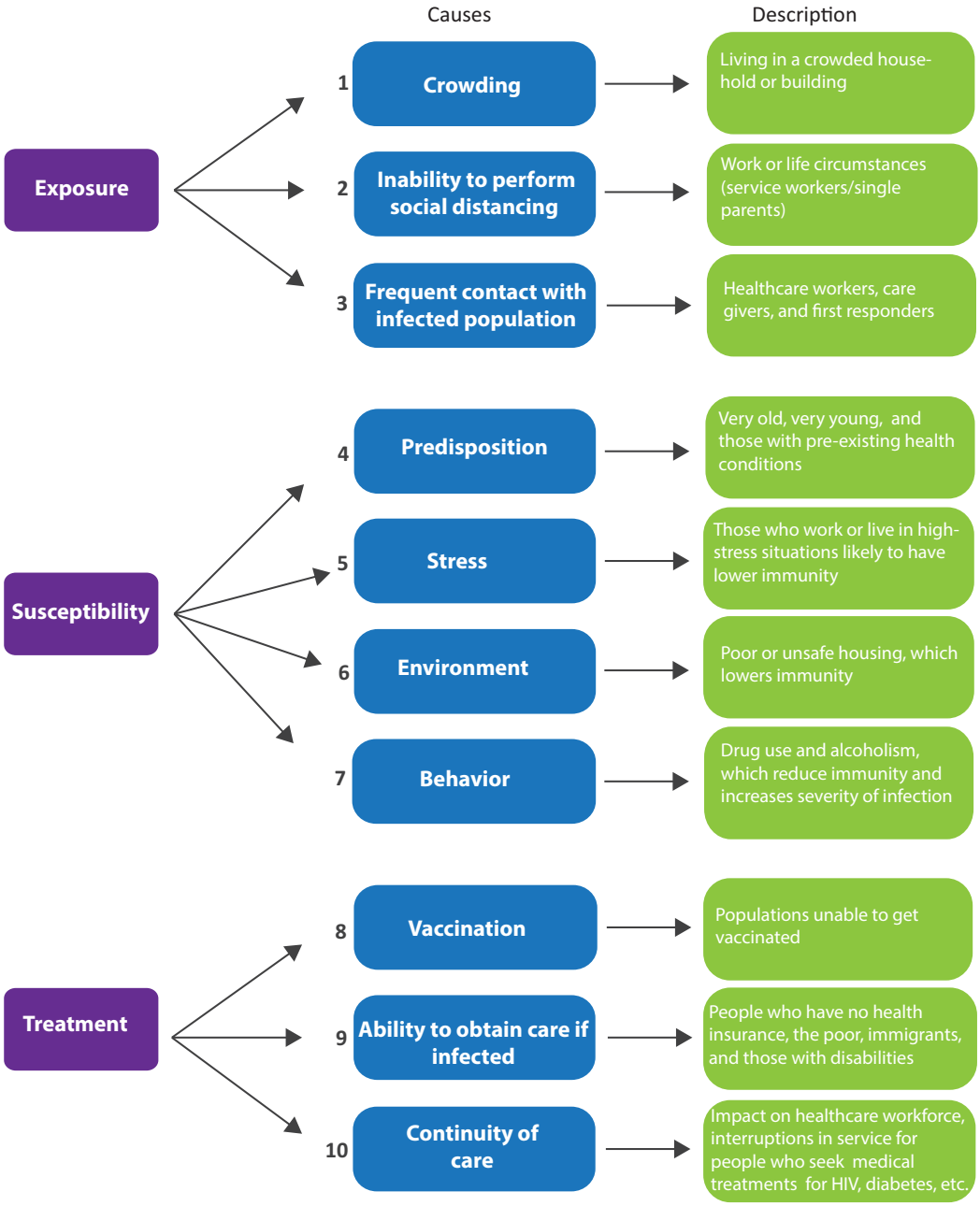
Access to Treatment

Lack of access to treatment may also increase vulnerability to pandemic flu. In general, people who do not have health insurance, low-income populations, immigrants, and people with disabilities have less access to treatment. In addition, populations unable or unwilling to get vaccinations or to obtain care if infected may be more vulnerable. Several studies have shown that African Americans get vaccinated at a lower rate than the rest of the population (Blumenshine et al).

The ability of healthcare facilities to maintain continuity of care is another important factor. Pandemic flu outbreaks can disrupt the continuity of care for those with pre-existing conditions (such as diabetes and HIV) because pandemics impact healthcare workers.

A disease with a high mortality or morbidity rate could have catastrophic economic impacts. The loss of the ability to acquire goods and services could affect every household in the state. Furthermore, disease outbreaks sometimes occur in waves, affecting the stability of certain economic sectors and their ability to recover before the next wave hits.

Figure 3.7.58: Conceptual Vulnerability Matrix (Source: DOHMH)



ii. Built Environment

In general, a disease outbreak will have little effect on property, with the possible exception that owner absenteeism, neglect, and lack of maintenance due to owner illness may cause property deterioration.

However, a disease outbreak has the potential to affect critical infrastructure. It may contribute to the disruption of basic services, including garbage collection and repairs to infrastructure (power, telephone, cable, etc.), should service workers fall ill. Because infrastructure sectors are interdependent, the impairment of one sector may cause the impairment of others.

A disease outbreak could have a direct impact on critical facilities. It would affect the operations of healthcare providers, which could, in turn, affect patient care. Increased employee and staff absences could, and most likely would, have an impact on service provision.

iii. Natural Environment

The environmental impacts of disease outbreaks largely depend on the type and severity of the disease. The condition of parks and open space could deteriorate should park maintenance workers succumb to illness. With catastrophic pandemics, the necessity for mass burials of animals or humans could affect the environment.

iv. Future Environment

In the future, population increase and density may exacerbate the exposure and susceptibility of people to disease outbreaks. In addition, global travel may amplify the probability of frequent outbreaks due to increased opportunities for exposure and transmission.

Climate change can also affect the spread of infectious diseases. According to the Natural Resources Defense Council (NRDC), warmer temperatures, shifting rainfall patterns, and high humidity increase the spread of vector-borne diseases such as West Nile virus.

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