



4.3.13 Pandemic

Pandemics are large-scale disease outbreaks, defined by how the disease spreads, not by how many fatalities are associated with it. A pandemic outbreak has several recognizable characteristics, including rapid, large-scale (potentially global) spread; overloaded healthcare systems; inadequate medical supplies; medical supply shortages; and a disrupted economy and society (Flu.gov 2015). Pandemics typically result from infectious diseases. An infectious disease, as defined by the World Health Organization (WHO), is caused by pathogenic organisms (e.g., bacteria, viruses, fungus, or parasites) that spread from one person to another, whether through direct or indirect contact. Zoonotic disease, a type of infectious disease, occurs when animals transmit a disease to humans (WHO 2015). Although any infectious disease can reach pandemic levels, influenza (flu) has the greatest likelihood of causing the next pandemic.

Of particular concern to Pike County are arthropod-borne viruses (arboviruses), which are viruses that are maintained in nature through biological transmission between susceptible hosts (mammals) and blood-feeding arthropods (mosquitos and ticks). More than 100 arboviruses can cause disease in humans; over 30 have been identified as human pathogens in the western hemisphere (New Jersey Department of Health and Senior Services 2008). Pike County has been impacted by various past and present infestations including: high population of mosquitoes (mosquito-borne diseases) and deer ticks (tick-borne diseases).

Mosquito-borne diseases are diseases that are spread through the bite of an infected female mosquito. Diseases of concern to Pike County include West Nile Virus. More recently, there has been an outbreak of Zika virus in the United States which is another mosquito-borne disease and a concern for the Commonwealth. Additionally, tick-borne diseases are bacterial or viral illnesses that spread to humans through infected ticks. Ticks become infected by microorganisms when feeding on small infected mammals (mice and voles). People who spend a lot of time outdoors have a greater risk of being bitten by an infected tick and becoming infected themselves. It is possible to be infected with more than one tick-borne disease at a time. Tick-borne diseases, including Lyme disease, are a major concern to Pike County.

In addition to arboviruses, Pike County has been impacted by influenza outbreaks in the past five years. Most recently, Pike County has been monitoring the Ebola virus, measles and Zika; however, there have been no cases in the County. For the purpose of this HMP update, the following diseases will be discussed in further detail: mosquito-borne (West Nile Virus), tick-borne (Lyme), influenza, measles, Ebola, and Zika.

West Nile Virus

West Nile Virus (WNV) encephalitis is a mosquito-borne viral disease, which can cause an inflammation of the brain. WNV is commonly found in Africa, West Asia, the Middle East and Europe. For the first time in North America, WNV was confirmed in New York City during the summer and fall of 1999. Since 2004, a continent-wide WNV epidemic flares up in the summer and continues into the fall as infected mosquitos spread the virus from birds to horses, humans and other animals (Pennsylvania Department of Health 2013).

Tick-Borne Diseases

Ticks can be infected with bacteria, viruses, or parasites. One of the more common tick-borne diseases in the Northeast is Lyme disease. Lyme disease is an illness caused by infection with the bacterium *Borrelia burgdorferi*, which is carried by infected ticks. Symptoms include fever, fatigue, headache, muscle aches, joint pain, a bull's eye rash may appear, and other symptoms that can be mistaken for viral infections, such as influenza or infectious mononucleosis. Pennsylvania has led the nation in confirmed cases of Lyme disease for three straight years and for the first time deer ticks have been found in each of Pennsylvania's 67 counties. In



2014, there were 7,400 cases of Lyme disease in the Commonwealth (Pennsylvania Department of Health 2016).

Influenza

The risk of a global influenza pandemic has increased over the last several years. This disease is capable of claiming thousands of lives and adversely affecting critical infrastructure and key resources. An influenza pandemic has the ability to reduce the health, safety, and welfare of the essential services workforce; immobilize core infrastructure; and induce fiscal instability.

Pandemic influenza is different from seasonal influenza (or "the flu") because outbreaks of seasonal flu are caused by viruses that are already among people. Pandemic influenza is caused by an influenza virus that is new to people and is likely to affect many more people than seasonal influenza. In addition, seasonal flu occurs every year, usually during the winter season, while the timing of an influenza pandemic is difficult to predict. A severe pandemic could change daily life for a time, including limitations on travel and public gatherings (Barry-Eaton District Health Department 2013).

At the national level, the CDC's Influenza Division has a long history of supporting the WHO and its global network of National Influenza Centers (NIC). With limited resources, most international assistance provided in the early years was through hands-on laboratory training of in-country staff, the annual provision of WHO reagent kits (produced and distributed by CDC), and technical consultations for vaccine strain selections. The Influenza Division also conducts epidemiologic research including vaccine studies and serologic assays and provides international outbreak investigation assistance (CDC 2011).

Measles

Measles is caused by a virus and is normally passed through direct contact and through the air. The virus infects the mucous membranes and then spreads throughout the body. It is highly contagious and considered a very serious disease. In 1980, before widespread vaccination, measles caused an estimated 2.6 million deaths each year. It still remains as one of the leading causes of death among young children. In 2013, approximately 145,700 people died, worldwide, from measles, with a majority of deaths being children under age 5 (World Health Organization 2015).

More recently, in 2015, 178 people from 24 states and Washington D.C. were reported to have measles, with one measles-related death. In recent years, the number of cases of measles has been on the rise as more parents elect not to vaccinate their children. Most of these cases were part of a large, ongoing outbreak linked to an amusement park in California. The United States experienced a record number of measles during 2014, with 644 cases from 24 states reported (New Jersey Department of Health 2015).

Ebola

Ebola, previously known as Ebola hemorrhagic fever, is a rare and deadly disease caused by infection with one of the Ebola virus strains. According to the CDC, the 2014 Ebola epidemic is the largest in history affecting multiple countries in West Africa. Two imported cases, including one death, and two locally-acquired cases in healthcare workers have been reported in the United States. The CDC and partners are taking precautions to prevent the further spread of Ebola in the United States (CDC 2016a).

Zika Virus

Zika virus is a generally mild illness that is spread primarily through the bite of an infected mosquito. . Zika virus can spread through sexual contact from a partner who has been infected with Zika virus. Although less



common, Zika virus can also be spread from a mother to baby during pregnancy or during the time of birth or through blood transfusion (Pennsylvania Department of Health 2016).

The current outbreak began in May 2015 in Brazil which led to reports of a neurological disease called Guillain-Barré syndrome and pregnant women giving birth to babies with birth defects such as microcephaly. The outbreak has spread to numerous countries and areas, prompting the Centers for Disease Control and Prevention (CDC) to issue travel notices to regions where the Zika virus transmission is ongoing. In response to the emerging disease, Pennsylvania has created a Zika Response Plan (Pennsylvania Department of Health 2016).

Location and Extent

Pandemic events cover a wide geographic area and can affect large populations; this can include multiple countries or continents. Size and extent of an infected population depends on how easily the illness is spread, mode of transmission, and amount of contact between infected and uninfected individuals. Locations with higher density populations are more susceptible to pandemic outbreaks, as the disease can be transmitted more easily, with the exception of Lyme disease. Additionally, vulnerable populations, especially the young and the elderly (who have weaker immune systems), are at greater risk for both contracting a disease and suffering fatal or severe consequences. Flu most frequently spreads through the air or by touch; when an infected person coughs, infected droplets go into the air or onto their hands, facilitating transmission of the disease to other people (WHO 2015).

When a pandemic or disease outbreak occurs, WHO and other public health institutions begin tracking the disease outbreak, treatment, and more. Ebola was a significant pandemic concern for American public health officials in 2014; however, the disease has primarily remained in Africa to date. Should a pandemic take hold in the United States, the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH) would be actively involved in managing the outbreak and treatment of the disease.

Influenza viruses with the potential to reach pandemic levels include the avian influenza A (H5N1) and avian influenza H7N9 (CDC 2015). Several years ago, the swine influenza (H1N1) was of particular concern. H1N1 was first detected in people in the United States in April 2009. On June 11, 2009, WHO signaled that a pandemic of 2009 H1N1 flu was underway (CDC 2009).

Although Ebola and Zika are still recognized as global health threats, Pike County is primarily concerned with the possibility of a pandemic flu outbreak and tick-borne diseases due to the presence of summer camps and sources of outdoor recreation in the County.

Range of Magnitude

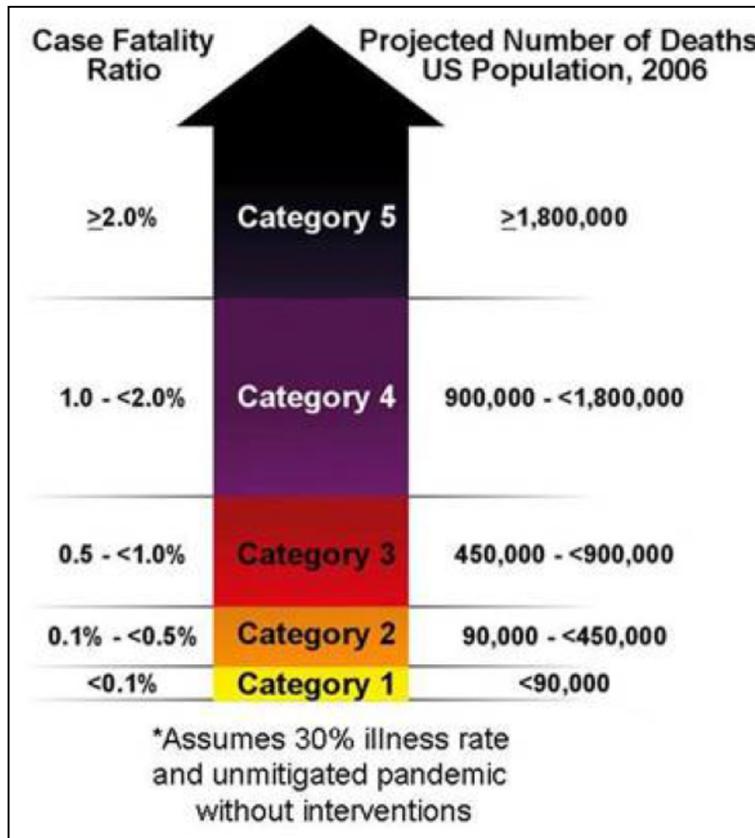
Severity of a pandemic depends on a number of factors, as indicated above. These include aggressiveness of the disease, ease of transmission, and factors associated with the impacted community (e.g., access to medical care, demographic data, and population density). Advancements in medical technologies have greatly reduced the number of deaths caused by influenza, the disease most likely to reach pandemic scale in Pennsylvania. Consequently, global effects of various influenza outbreaks have declined over the past century. High-risk populations considered more vulnerable to various pandemic diseases are described in the vulnerability assessment.

The severity and length of the next pandemic cannot be predicted. Based on previous pandemics and without medications or vaccines available, it is estimated that a severe pandemic could cause almost 2 million deaths in the United States, more than 9 million hospitalizations, and more than 90 million people ill (New Jersey Department of Health [NJDOH] 2012).



The CDC and Prevention Community Strategy for Pandemic Influenza Mitigation guidance introduced a Pandemic Severity Index (PSI), which uses the case fatality ratio as the critical driver for categorizing the severity of a pandemic. The index is designed to estimate the severity of a pandemic on a population to allow better forecasting of the impact of a pandemic, and to enable recommendations on the use of mitigation interventions that are matched to the severity of influenza pandemic. Pandemics are assigned to one of five discrete categories of increasing severity (Category 1 to Category 5) (CDC 2016b). Figure 4.3.13-1 illustrates the five categories of the PSI.

Figure 4.3.13-1. Pandemic Severity Index



Source: CDC 2016b

WHO described a series of pandemic phases in 1999 and revised these in 2005 and 2009 to provide a global framework and aid in pandemic preparedness and response planning. In addition to facilitating implementation of preparedness recommendations, the phases also help provide greater understanding of when an event is considered to have reached pandemic levels. The six phases are shown on Figure 4.3.13-2 below and are described as follows:

- Phase 1: No viruses circulating among animals have been reported among humans.
- Phase 2: An animal influenza virus circulating among domesticated or wild animals has caused known infection in humans and is now considered a potential pandemic threat.
- Phase 3: An animal or human-animal influenza reassortment virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain

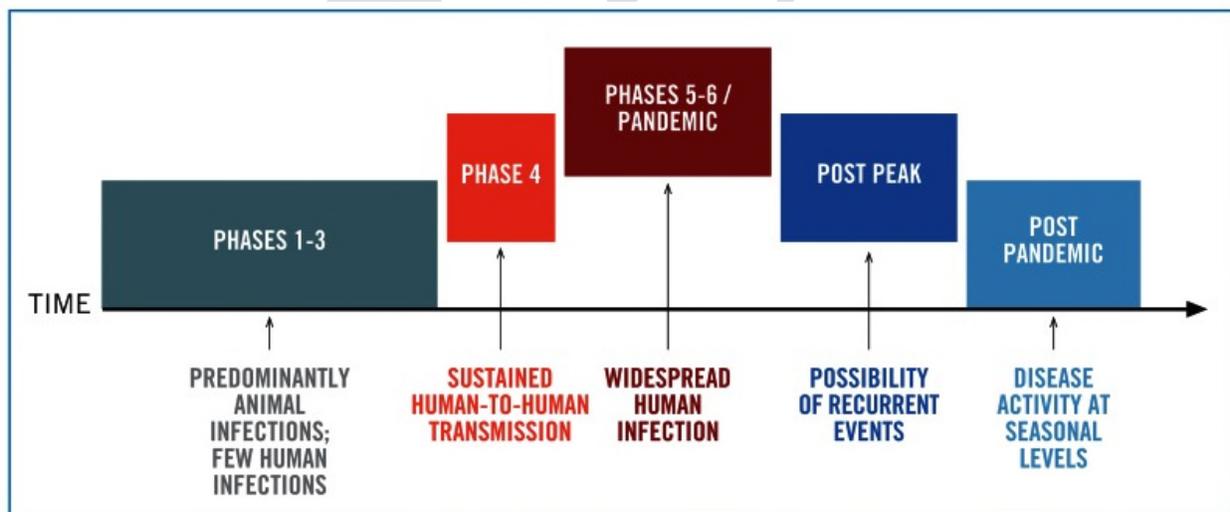


community-level outbreaks. Limited human-to-human transmission may occur under some circumstances, such as close contact between an infected person and an unprotected caregiver.

- Phase 4: Verified human-to-human transmission of an animal or human-animal influenza reassortment virus is able to cause “community-level outbreaks.” The ability to cause sustained disease outbreaks in a community marks a significant upwards shift in the risk of a pandemic. Any country that suspects or has verified such an event should urgently consult with WHO so that the situation can be jointly assessed and a decision made by the affected country if implementation of a rapid pandemic containment operation is warranted. Phase 4 indicates a significant increase in risk of a pandemic but does not necessarily mean that a pandemic is a forgone conclusion.
- Phase 5: There has been human-to-human spread of the virus into at least two countries in one WHO region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent, and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.
- Phase 6: The pandemic phase is characterized by community-level outbreaks in at least one other country in a different WHO region, in addition to the criteria defined in Phase 5. Phase 6 indicates a global pandemic is underway.

Conclusion of Phase 6 leads to the post-peak period, wherein pandemic levels decrease in most countries with surveillance capabilities. Despite a decrease in activity, countries still must be prepared for additional waves of the pandemic. Pandemic waves can be separated by a period of months, leading to a long recovery time to guarantee entry of the pandemic into the post-pandemic phase (WHO 2009).

Figure 4.3.13-2. Pandemic Influenza Phases



Source: WHO 2009

A worst-case scenario would be entry of the United States into a Phase 6-designation of an influenza or other pandemic, whereby local community outbreaks would occur in Pike County. This would affect most of the population, causing significant numbers of fatalities and disrupting normal living conditions. The most likely scenario is a seasonal flu or a Phase 3- or 4-designation. In these cases, a few residents might get sick, but most of the County would not be directly impacted.



Mosquito-Borne Diseases

Since it was discovered in the western hemisphere, WNV has spread rapidly across North America, affecting thousands of birds, horses and humans. WNV swept from the New York City region in 1999 to almost all of the continental U.S., seven Canadian provinces and throughout Mexico and parts of the Caribbean by 2004 (USGS 2016). The CDC has a surveillance program for WNV. Data is collected on a weekly basis and reported for five categories: wild birds, sentinel chicken flocks, human cases, veterinary cases and mosquito surveillance (CDC 2011).

For Zika virus, the CDC is tracking the spread of the virus in the United States and around the world. On January 22, 2016, CDC activated its Emergency Operations Center (EOC) to respond to outbreaks of Zika occurring in the Americas and increased reports of birth defects and Guillain-Barré syndrome in areas affected by Zika. On February 8, 2016, CDC elevated its EOC activation to a Level 1, the highest level (CDC 2016c).

Tick-Borne Diseases

Lyme disease is the most commonly reported vector-borne illness in the U.S. In 2009, it was the fifth most common nationally notifiable disease. In 2014, 96% of Lyme disease cases in the U.S. were reported from 14 states, which included Pennsylvania (CDC 2015). Between 2000 and 2014, there were 625 confirmed cases of Lyme disease in Pike County (CDC 2015). The Yale School of Public Health mapped Lyme disease risk for the northeast United States. According to their work, Pike County is at high risk for Lyme disease in humans (Yale School of Public Health 2014).

Typical symptoms include fever, headache, fatigue, and a characteristic skin rash called erythema migrans. If left untreated, infection can spread to joints, the heart, and the nervous system. Patients with Lyme disease are frequently misdiagnosed with chronic fatigue syndrome, fibromyalgia, multiple sclerosis, and various psychiatric illnesses, including depression. Misdiagnosis with these other diseases may delay the correct diagnosis and treatment as the underlying infection progresses unchecked.

Influenza, Measles and Ebola

The exact size and extent of an infected population depends on how easily the illness will spread, the mode of transmission, and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in more densely populated areas. The Ebola virus is spread to others through direct contact; it is not spread through the air like influenza.

Pandemic flu should not be confused with seasonal flu. Seasonal flu is a less severe concern because of its regularity of occurrence and predictability. The following Table 4.3.13-1 lists key differences between pandemic and seasonal flus.

Table 4.3.13-1. Seasonal Flu vs Pandemic Flu

Pandemic Flu	Seasonal Flu
Rarely happens (three times in 20 th century).	Happens annually and usually peaks in January or February.
People have little or no immunity because they have no previous exposure to the virus.	Usually some immunity built up from previous exposure.
Healthy people may be at increased risk for serious complications.	Usually only people at high risk, not healthy adults, are at risk of serious complications.
Healthcare providers and hospitals may be overwhelmed.	Healthcare providers and hospitals can usually meet public and patient needs.
Vaccine probably would not be available in the early stages of a pandemic.	Vaccine available for annual flu season.
Effective antivirals may be in limited supply	Adequate supplies of antivirals are usually available.
Number of deaths could be high (U.S. death toll during the	Seasonal flu-associated deaths in the U.S. over 30 years



Pandemic Flu	Seasonal Flu
1918 pandemic was approximately 675,000).	ending in 2007 have ranged from about 3,000 per season to about 49,000 per season.
Symptoms may be more severe	Symptoms include fever, cough, runny nose, and muscle pain.
May cause major impact on the general public, such as widespread travel restrictions and school or business closings.	Usually causes minor impact on the general public; some schools may close and sick people are encouraged to stay home.
Potential for severe impact on domestic and world economy.	Manageable impact on domestic and world economy.

Source: Flu.gov 2015

Approximately 12,470 Americans died from H1N1 within a roughly 1-year period from April 2009 to April 2010 (CDC, 2010). Between October 2014 and late May 2015, 6.4% of deaths were attributable to pneumonia and influenza—below the epidemic threshold of 6.6% (an epidemic occurs when incidence rate exceeds expected rate but is not at the magnitude of a pandemic) (CDC FluView 2015).

Past Occurrence

The following section provides information regarding past occurrences of pandemic events.

West Nile Virus

West Nile Virus arrived in the United States in 1999 and was first detected in Pike County in 2000 when mosquito pools, dead birds and/or horses tested positive for the virus. Since then, the number of positive counties in Pennsylvania, human cases, and West Nile deaths has fluctuated with the temperature and precipitation each year. Table 4.3.13-2 illustrates the virus’s overall cases, human cases, and mortality from 2001-2010. In Pike County, there have been birds and mosquitoes that have tested positive for the virus, however no positive human cases and therefore no human deaths.

Table 4.3.13-2. Previous West Nile Virus occurrences in Pike County from 2001-2016

Year	Number Of Positive Cases	Positive Human Cases	Human Deaths
2001	1	0	0
2002	4	0	0
2003	13	0	0
2004	1	0	0
2005	0	0	0
2006	1	0	0
2007	1	0	0
2008	0	0	0
2009	0	0	0
2010	0	0	0
2011	1	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	0

Source: PA West Nile Control Project 2016



Tick-Borne Diseases

Pennsylvania has led the nation in confirmed cases of Lyme disease for three straight years and for the first time deer ticks have been found in each of Pennsylvania’s 67 counties. Table 4.3.13-3 shows the number of reported cases of Lyme disease in Pike County from 2000 to 2014.

Table 4.3.13-3. Previous Lyme Disease Occurrences in Pike County from 2000-2014

Year	Number Of Reported Cases
2000	14
2001	14
2002	22
2003	46
2004	48
2005	46
2006	27
2007	57
2008	44
2009	37
2010	18
2011	19
2012	13
2013	39
2014	51

Source: Pennsylvania Department of Health 2016

Influenza

The United States Department of Health and Human Services estimates that influenza pandemics have occurred for at least 300 years at unpredictable intervals. There have been several pandemic influenza outbreaks over the past 100 years. A list of events worldwide is shown in Table 4.3.13-4.

Table 4.3.13-4. List of previous significant outbreaks of influenza over the past century

Date	Pandemic Name/Subtype	Worldwide Deaths (Approximate)
1918-1920	Spanish Flu / H1N1	50 million
1957-1958	Asian Flu / H2N2	1.5-2 million
1968-1969	Hong Kong Flu / H3N2	1 million
2009-2010	Swine Flu / 2009 H1N1	18,036

Source: Global Security, 2009; World Health Organization, 2009

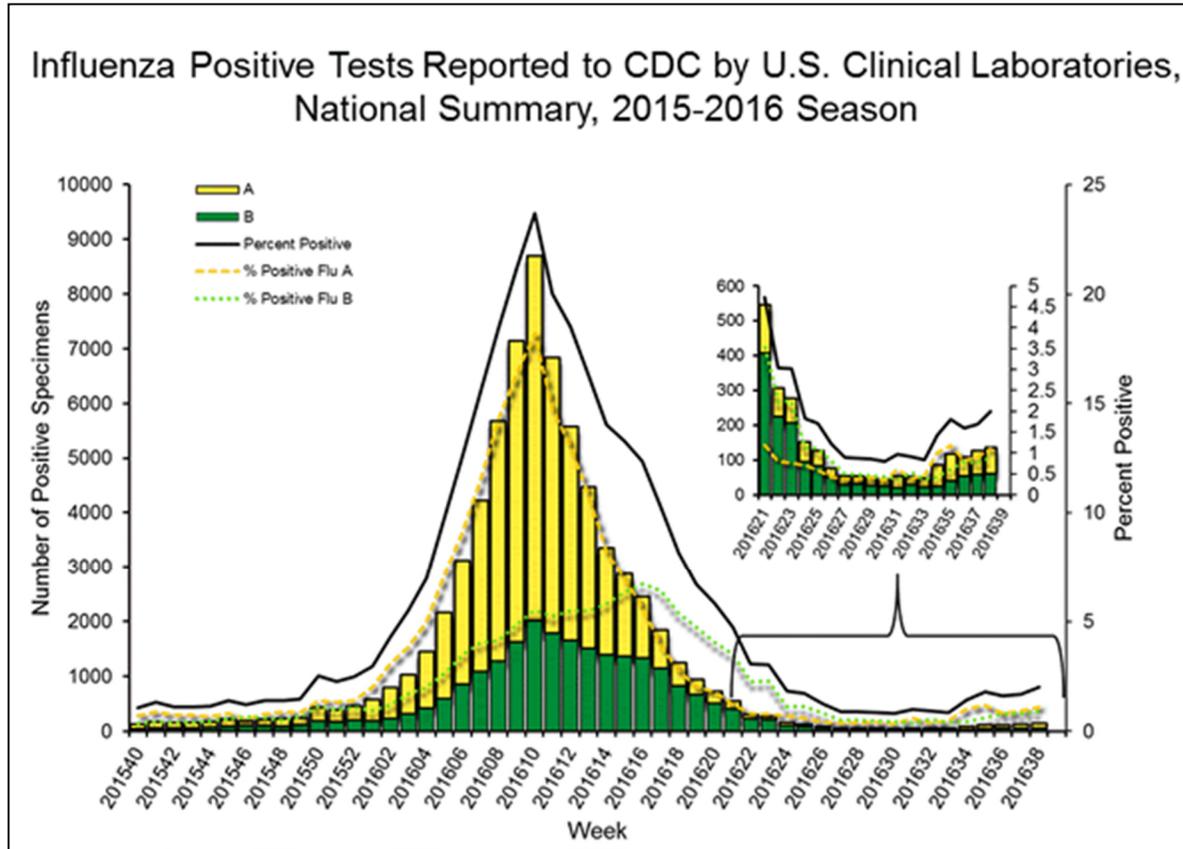
Deaths occurred in the United States as a result of the Spanish Flu, Asian flu, and Hong Kong Flu outbreaks. The Spanish Flu claimed 500,000 lives in the United States, and there were 350,000 cases in Pennsylvania – 150,000 were in Philadelphia alone. Most deaths resulting from the Asian flu occurred between September 1957 and March 1958; there were about 70,000 deaths in the United States and approximately 15% of the population of Pennsylvania was affected. The first cases of the Hong Kong Flu in the U.S. were detected in September 1968 with deaths peaking between December 1968 and January 1969 (Global Security, 2009). More recently, 43 cases of 2009 H1N1 have been confirmed in Pike County resulting in 1 death.





Epidemiologists and public health officials consistently track the rate of influenza or influenza-like-illnesses (ILI) to monitor potential pandemic threats. This also allows them to provide annual data on ILI seasonal outbreaks. Figure 4.3.13-3 below shows the biweekly national number of cases of ILI during the 2015-2016 season, distinguishing each type of ILI by a unique color.

Figure 4.3.13-3. ILI Cases in the United States, 2015-2016 Season



Source: CDC Weekly Flu 2016d

In the mid-Atlantic region, which includes the State of Pennsylvania and Pike County, the following numbers of positive ILI tests were reported:

- A (H1) – 0
- A (Unable to subtype) – 0
- A (H3) – 6
- 2009 N1N1 – 0
- A (Subtyping not performed) – 0
- B – 0
- N3N2v – 0 (CDC 2016e)

The Pennsylvania Department of Health maintains an influenza surveillance data archive that provides summaries for each influenza season, dating back to 2005/2006. Table 4.3.13-5 shows the number of reported cases of influenza in Pike County from 2005 to 2015.



Table 4.3.13-5. Reported Influenza Cases in Pike County, 2005-2015

Year	Number Of Reported Cases
2005	32
2006	5
2007	36
2008	38
2009	76
2010	28
2011	7
2012	92
2013	68
2014	71
2015	103
TOTAL	556

Source: Pennsylvania Department of Health 2016

Measles

According to the CDC, in 2014, the United States experienced a record number of measles cases, with 667 cases reported in 27 states. That was the greatest number of cases since measles elimination was documented in 2000. In 2015, 189 people from 24 states were reported to have measles. Recently, from January 2 to September 10, 2016, there were 54 reports cases in 16 states (Alabama, Arizona, California, Colorado, Connecticut, Florida, Georgia, Hawaii, Illinois, Massachusetts, Minnesota, New York, North Carolina, Tennessee, Texas, and Utah). The most recent outbreak, which occurred in 2015, was linked to an amusement park in California. The outbreak likely started from a traveler who became infected overseas with measles, then visited the amusement park while infectious; however, no source was identified (CDC 2016f). There were reported cases of measles in Pennsylvania during this outbreak (CDC 2015).

Ebola

The first outbreak of Ebola occurred in 1976 in Zaire (Democratic Republic of the Congo). Since then, there has been additional outbreaks and known cases identified. The most recent being the 2014 outbreak which was the largest Ebola outbreak in West Africa. In the United States, there were two imported cases, one death and two locally acquired cases in healthcare workers have been reported.

Table 4.3.13-6 lists the outbreaks of Ebola since it was first identified in 1976.



Table 4.3.13-6. List of Previous Significant Outbreaks of Ebola

Date(s)	Country Impacted	Reported Number of Human Cases	Reported Number (%) of Deaths Among Cases
1976	Zaire	318	280 (88%)
1995	DRC	315	250 (79%)
2000-2001	Uganda	425	224 (53%)
2001-2002	Republic of Congo	57	43 (75%)
2007	DRC	264	187 (71%)
2007	Western Uganda	149	37 (25%)
2014	West Africa	27,000*	11,000* (41%)

Source: CDC 2016

* As of July 18, 2015

DRC Democratic Republic of the Congo

Zika Virus

Outbreaks of Zika virus disease have been recorded in Africa, the Americas, Asia and the Pacific. Zika virus was first identified in Uganda in 1947 in monkeys through a network that monitored yellow fever. It was later identified in humans in 1952 in Uganda and the United Republic of Tanzania. From the 1960s to 1980s, human infections were found in Africa and Asia, typically accompanied by mild illness. The first large outbreak of disease caused by Zika infection was reported from the Island of Yap (Federated States of Micronesia) in 2007. In July 2015, Brazil reported an association between Zika virus infection and Guillain-Barré syndrome and in October 2015, Brazil reported an association between Zika virus infection and microcephaly (WHO 2016). In the United States, as of September 28, 2016, there have been 3,625 reported cases of Zika virus. This includes 129 cases in Pennsylvania, all travel-associated; however, no cases have been identified in Pike County (CDC 2016g).

Future Occurrence

Predicting the future occurrences of pandemics is difficult; however, based on the history of occurrences in Pike County, it is likely that the County will be impacted by certain diseases in the future. Additionally, an increase in population and population density in the County has the potential to increase exposure and susceptibility of its residents to outbreaks. Infected mosquitos and ticks will continue to inhabit and impact the County.

Future occurrences of pandemic West Nile Virus are unclear. Instances of the virus have been generally decreasing due to aggressive planning and eradication efforts, but some scientists suggest that as global temperatures rise and extreme weather conditions occur due to climate change, the range of the virus in the United States will grow (Epstein 2001).

Tick-borne diseases including Lyme disease will continue to impact the northeast United States, Pennsylvania and Pike County due to its natural environment. Each year, the number of cases increases. Research continues to address concerns of the disease (CDC 2014). Climate has been linked to one of the factors that influence the transmission, distribution, and incidence of Lyme disease. Studies have provided evidence that climate change has also contributed to the expanded range of ticks, increasing the potential risk of Lyme disease (EPA 2016).

As with West Nile Virus, the precise timing of pandemic influenza is uncertain. Based on historical events, Pike County is expected to experience pandemic influenza outbreaks approximately every 11 to 41 years. The precise timing of pandemic influenza is uncertain, but occurrences are most likely when the Influenza Type A virus makes a dramatic change, or antigenic shift, that results in a new or “novel” virus to which the population



has no immunity. This emergence of a novel virus is the first step toward a pandemic (US Health and Human Services 2009).

Adults and children who contracted measles during the most recent outbreak were reported to have not been vaccinated against the disease or they did not know if they were ever vaccinated. For every 1,000 children who get measles, one to three of them will die from the disease (Connell 2015). If the number of vaccinations for measles decreases, there may be an increase number of reported cases.

For the 2017 HMP update, the most up-to-date data was collected to calculate the probability of future occurrence of pandemic events for Pike County. Information from the CDC, Pennsylvania Department of Health, and Pennsylvania West Nile Virus Control Program were used to identify the number of disease occurrences and pandemic events that occurred between 1950 and 2015. Using these sources ensures the most accurate probability estimates possible. The table below shows these statistics, as well as the annual average number of events and the estimate percent chance of an incident occurring in a given year. Based on these statistics, there is an estimated 100-percent chance of a pandemic event or an occurrence of a disease occurring in any given year in Pike County.

Table 4.3.13-7. Probability of Future Occurrences of Disease Outbreak in Pike County

Hazard Type	Number of Occurrences Between 1950 and 2015	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in any given year	Percent chance of occurrence in any given year
West Nile Virus	0	0.00	0	0	0%
Lyme Disease	491	7.55	0.13	1.0	100%
Influenza	556	8.55	0.12	1.0	100%
Measles	0	0.00	0	0	0%
Ebola	0	0.00	0	0	0%
Zika	0	0.00	0	0	0%

Source: Pennsylvania Department of Health 2016; Pennsylvania West Nile Virus Control Program 2016

Based on previous occurrences of the various diseases, pandemics and outbreaks of the different diseases will continue to occur. However, it is uncertain as to the future of these diseases and their impacts on Pike County. Future pandemics may also emerge from other diseases, especially invasive pathogens that County residents do not have natural immunity to. Overall, the probability of future pandemic events are considered *highly likely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

Vulnerability Assessment

Depending on characteristics of the disease/virus, certain population groups can be at higher risk of infection. Regarding seasonal influenza, about 60% of hospitalizations and 90% of flu-related deaths occur among people 65 and older. However, during the relatively recent H1N1 pandemic, 90% of hospitalizations and 87% of H1N1-related deaths occurred in people younger than 65. As with seasonal flu, people with underlying health conditions faced a much higher probability of contracting H1N1. Schools, convalescent centers, and other institutions are highly conducive to faster transmission of pandemic diseases (CDC 2010). Section 2 of this Plan provides information on vulnerable populations in Pike County.



Should a pandemic reach Pike County, the County's doctors and other health professionals should expect to see additional outpatient visits. There are no hospitals located within the County so if a pandemic that would require hospitalization were to occur, Pike County residents would have to rely on facilities either in Port Jervis, NY, Newton, NJ, Stroudsburg, PA, Bartonsville, PA, Honesdale, PA or Scranton, PA.

In addition, if a pandemic were to affect a nearby county, Pike County may expect to see an influx of people entering the County. This will increase the vulnerability of Pike County's current residents.

Pike County also experiences high tourism, particularly from more metropolitan areas. Tourists entering the County could be carrying a virus which may spread to current residents and cause a potential outbreak.

Effect of Climate Change on Vulnerability

The relationship between climate change and infectious diseases is somewhat controversial. The notion that rising temperatures will increase the number of mosquitoes that can transmit malaria or other diseases among humans (rather than just shift their range) has been the subject of debate over the past decade. Some believe that climate change may affect the spread of disease, while others are not convinced. However, many researchers point out that climate is not the only force at work in increasing the spread of infectious diseases into the future. Other factors, such as expanded rapid travel and evolution of resistance to medical treatments, are already changing the ways pathogens infect people, plants, and animals. As climate change potentially accelerates, it is likely to work synergistically with many of these factors, especially in populations increasingly subject to massive migration and malnutrition (Harmon 2010).