RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

NJ Climate Adaptation Alliance

March 2014

A Summary of Climate Change Impacts and Preparedness Opportunities for the Public Health Sector in New Jersey

This report is one of a series of working briefs prepared by the New Jersey Climate Adaptation Alliance to provide background information on projected climate impacts for six major sectors in New Jersey, including agriculture, built infrastructure (utilities and transportation), coastal communities, natural resources, public health, and water resources. These working briefs present information to be used throughout the Alliance's deliberations to develop recommendations for state and local public policy that will enhance climate change preparedness and resilience in New Jersey. These briefs are living documents that are periodically updated. This document updates a prior version from January 2013. For more information about the Alliance and its activities, visit *http://njadapt.rutgers.edu*.

This report provides an assessment of public health-based perspectives on the topic of adaptation planning for climate change in New Jersey, including a description of health care facilities and services in the state, existing emergency response capacities and communications systems, and other applicable descriptive information. Current New Jersey efforts as well as current and planned adaptation practices and strategies in other states are presented as the basis for a series of recommendations to address additional needs as a starting point for discussion and prioritization of comprehensive adaptation planning for New Jersey.

Public Health Resources in New Jersey

New Jersey has a population of approximately 8.7 million people, with 14% of the population (1.1 million people) aged 65 and over, and 25% of the population (2.1 million people) aged 18 and under.[1] Seventeen percent of New Jersey residents have incomes below the Federal Poverty Level as measured by the U.S. Department of Health and Human Services' (HHS) poverty guidelines.[2] Insurance coverage levels in New Jersey are on par with the nation as a whole: 54% have health insurance through employers, 25% are covered through Medicare or Medicaid, 4% are covered by individual plans, and 16% of residents in the state are uninsured.[3]

Public health and treatment in New Jersey is provided by a range of acute and long-term care facilities and agencies, including hospitals, federally qualified health care centers (FQHCs), nursing homes and assisted living facilities, home health and hospice agencies, local health departments, Emergency Medical Services, the NJ Medical Reserve Corps, and the NJ Office of Emergency Management. Most facilities are licensed and regulated by the New Jersey Department of Health (DOH). There are 73 hospitals in New Jersey with a capacity of 2.4 beds per 1,000 people,[4] 362 certified nursing facilities with approximately 51,000 beds,[5] and 20 FQHCs.[6] According to a 2008 report by the New Jersey Commission on Rationalizing Health Care Resources, "overall average occupancy ratio of New Jersey hospitals is above the national average, but in every hospital market area of New Jersey it is still below the normative 80% to 85% range considered 'full occupancy'." The Commission concluded that hospitals in New Jersey are in poorer financial condition than those in other states; New Jersey hospitals perform worse than the national average on

[1] Kaiser Family Foundation (2012a)
[2] Kaiser Family Foundation (2012a)
[3] Kaiser Family Foundation (2012a)
[4] Kaiser Family Foundation (2012b)
[5] Kaiser Family Foundation (2012c)
[6] Kaiser Family Foundation (2012d)

financial indicators such as operating margin, debt service coverage ratio, and long-term debt to capitalization.[7] The most financially stressed hospitals are mostly located in the northeastern region of the State, have a high volume of publicly-insured patients, and a low volume of surgical cases.[8]

New Jersey is characterized by a decentralized public health system. Public health is overseen by the state's Department of Health (DOH); primary responsibility for services lies with local public health agencies, per the Local Health Services Act (statute N.J.S.A. 26:3A2-10.c).[9] There are 94 local health departments covering the state's 565 municipalities. These local health departments (LHDs) vary in size and structure; 20 are county health departments, 7 are regional health commissions, 35 are municipal health departments serving multiple municipalities by interlocal agreement, and 32 are standalone municipal health departments, typically serving the larger cities.[10] Each LHD is required to assure provision of the services set forth in the *Public Health Practice Standards for Local Boards of Health in New Jersey* (N.J.A.C. 8:52). Typical services provided by the local health departments include preventive care, immunizations, investigation of communicable diseases, environmental health and sanitary code inspections, public health education, and emergency planning and response. However, there is a wide variation between the local health departments in the number and type of services performed, the number of people served, and the amount of money spent per capita on public health.[11] New Jersey ranks 30th nationally in terms of per capita state expenditures on local public health,[12] and consequently, local health departments in New Jersey are heavily dependent on local taxes for funding.

DOH has designated 21 of these local health departments as LINCS (Local Information Network and Communication System) agencies to coordinate health emergency planning and response. These LINCS agencies developed an online Health Alert Network to facilitate communication and sharing of information amongst public health professionals, providers, and organizations in New Jersey.[13,14] Additionally, there are 15 Governmental Public Health Partnerships (GPHPs) made up of representatives from each local health department within the county, whose responsibility it is to coordinate public health planning and emergency preparedness amongst LHDs, hospitals, FQHCs, community service providers, local businesses and other partners on a county level. Each GPHP produced a county-wide Community Health Improvement Plan (CHIP) to identify high-priority public health issues for their county.[15]

At the state level, the Division of Public Health Infrastructure, Laboratories and Emergency Preparedness (PHILEP) is responsible for overseeing emergency preparedness, the local public health agencies, and the state laboratories. A Strategic Plan has been prepared outlining New Jersey's strategy to better coordinate the local health departments in case of emergency, with a goal of integrating the electronic networks of the various health providers and agencies across the state.[16] The Public Health and Environmental Laboratories, under PHILEP, provides an array of laboratory testing capabilities and assists with biological and chemical threat preparedness, ensuring water quality, identifying infectious disease outbreaks, and screening for diseases,[17] in concert with the state's Communicable Disease Service (CDS), which works with LHDs to investigate outbreaks and provides technical support. Physicians, hospitals, laboratories, local health departments, long term care facilities, correctional institutions and schools submit disease reports to the Communicable Disease Reporting and Surveillance System (CDRSS), a web-based database monitored by the CDS's Infectious and Zoonotic Disease program.[18] A 2009 assessment of state public health performance in New

[7] New Jersey Commission on Rationalization Health Care Resources (2008)
[8] New Jersey Commission on Rationalization Health Care Resources (2008)
[9] N.J.S.A. 26:3A2-10.c
[10] NJDOH (2013)
[11] New Jersey Department of Health and Senior Services (2008a)
[12] United Health Foundation (2011)
[13] New Jersey Department of Health and Senior Services (n.d.): Responding to Public Health Emergencies
[14] New Jersey Department of Health and Senior Services (2012f)
[15] New Jersey Department of Health and Senior Services (2012d)
[16] New Jersey Department of Health and Senior Services (n.d.): Responding to Public Health Emergencies
[17] New Jersey Department of Health and Senior Service (2012e)
[18] New Jersey Department of Health and Senior Service (2012b)

Jersey noted that while data collection is mandatory, there is no mandate to use the data, and that it is difficult to obtain or share data across jurisdictions.[19]

Though DOH has primary responsibility and regulatory authority over healthcare provision in New Jersey, the state Department of Human Services (DHS) administers most programs related to vulnerable populations, including programs for the poor, elderly, and disabled. DHS works to provide access to medical care for these populations; the Division of Medical Assistance and Health Services (DMAHS) administers the state and federally funded Medicaid and NJ FamilyCare programs for low- to moderate- income families. Mental health services are also coordinated by DHS under the Division of Mental Health Services, which includes a Disaster and Terrorism branch that provides resources specifically related to crisis counseling.

Other state agencies and commissions, including the Health Care Facilities Financing Authority, the Department of Veterans affairs, the Department of Children and Families, and the Department of Environmental Protection also play a role in regulating and providing services related to public health.

Potential Sector Impacts

The impacts of climate change on human health can broadly be sorted into the following four categories:

1. Heat-Related Illnesses
2. Air Quality Conditions
3. Storm-Related Injuries and Stresses
4. Infectious Diseases

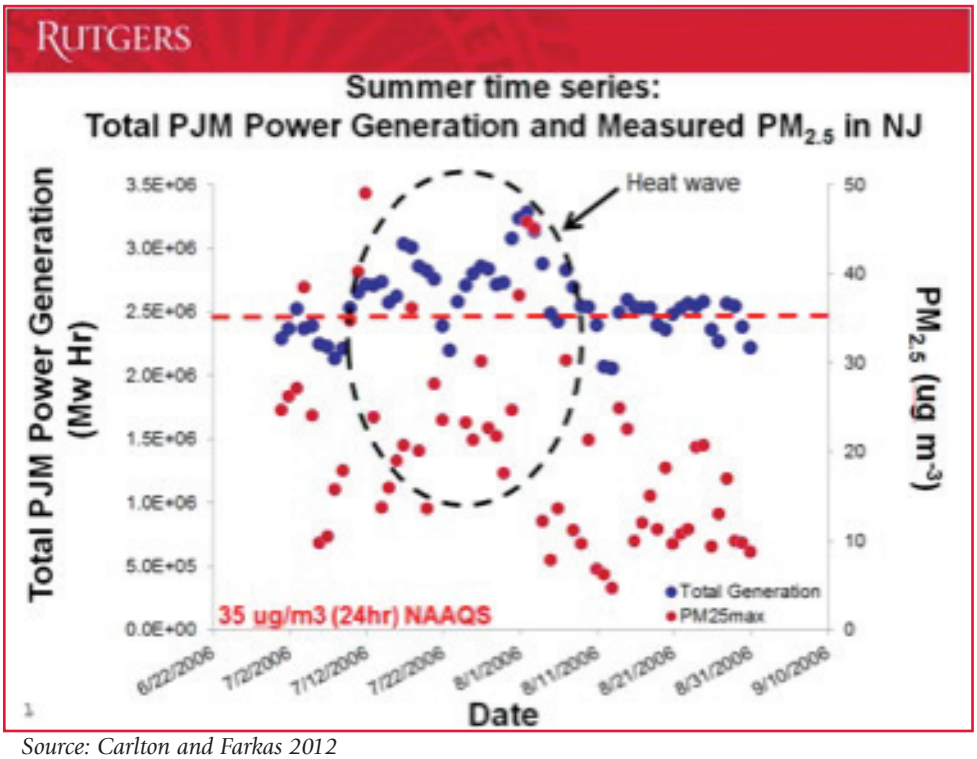
Heat-Related Illnesses

One of the predicted outcomes of climate change is that average temperatures will continue to rise, which will be especially noticeable in the summer.[20] Heat waves are expected to increase in both frequency and intensity.[21] Exposure to extreme heat can result in heat stress,[22] which manifests itself in several ways including heat stroke, heat exhaustion, heat syncope (fainting), heat cramps, or heat rashes.[23] Heat can exacerbate existing chronic health conditions, including cardiovascular and respiratory diseases,[24] and has been shown to cause kidney stones[25] and renal failure.[26] Diabetics have an increased risk of heat-related mortality,[27] as do people on certain medications, particularly diuretics, which have a dehydrating effect.[28]

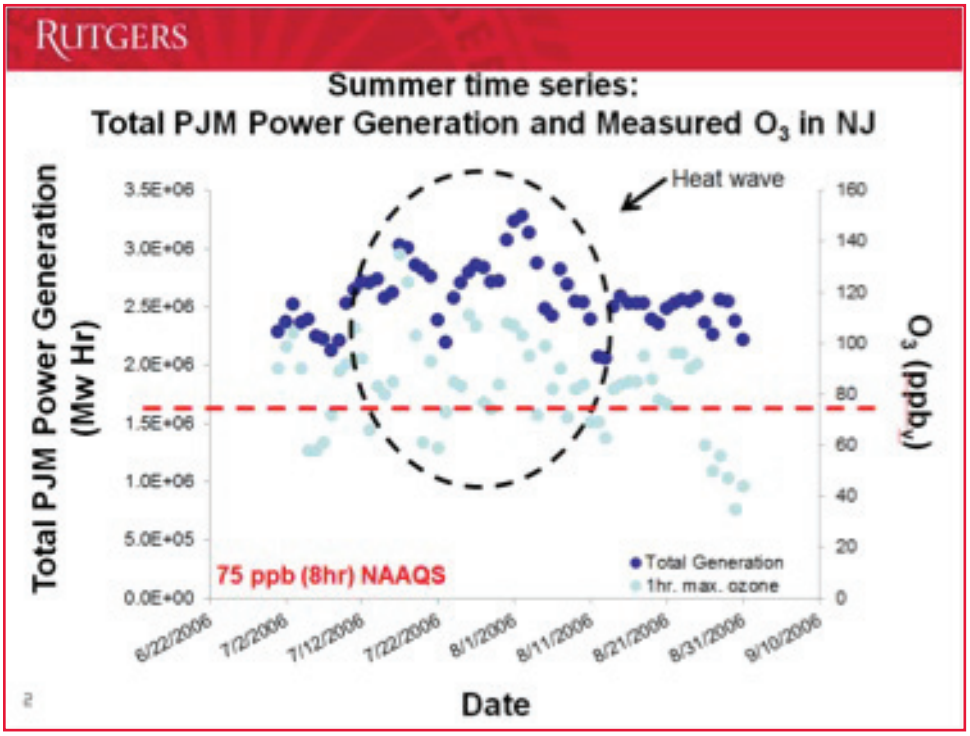
Elderly people are especially susceptible to heat-related morbidity and mortality.[29] Other vulnerable populations include the very young, the obese, those lacking access to air conditioning, and outdoor laborers.[30] Urban heat islands may increase heat-related health impacts for city dwellers by "raising air temperatures in cities 2-10°F over surrounding suburban and rural areas due to lack of vegetation and absorption of heat by paved surfaces and buildings."[31]

Heat is already the leading cause of weather-related death in the United States; from 1999-2003, 3,442 deaths were reported as a result of excessive heat.[32] The extreme heat wave experienced by Europe in the summer of 2003 caused more than 70,000 excess deaths,[33] showing the extent to which extreme heat can have an impact on public health without proper systems in place.

[19] Holleran (2009)
[20] Broccoli et al (2013)
[21] USGCRP (2013)
[22] USCCSP (2008)
[23] Centers for Disease Control (2012a)
[24] USCCSP (2008)
[25] Brikowski (2008)
[26] Semenza (1999)
[27] Schwartz (2005)
[28] USGCRP (2009)
[29] Basu (2005)
[30] USCCSP (2008)
[31] USCCSP (2008)
[32] Luber and Conklin (2006)
[33] Robine et al (2008)



Source: Carlton and Farkas 2012



Source: Carlton and Farkas 2012

Air Quality Conditions

Because ozone formation increases with more sunlight and higher temperatures, and typically reaches peak concentrations during the summer, a warmer climate and extended heat waves will lead to an increase in levels of ground level ozone. Ozone is caused by the interaction between nitrogen oxides and volatile organic compounds, which can occur naturally but is primarily the result of burning fossil fuels, especially from the transportation sector. "Breathing ozone damages the cells lining the lungs and results in short-term decreases in lung function."[34] "Exposure to elevated concentrations of ozone is associated with a variety of health impacts, including pneumonia, chronic obstructed pulmonary disease, asthma, allergic rhinitis and other respiratory diseases, and an increased likelihood of premature mortality."[35] People who spend more time outdoors, such as children and outdoor workers, are more vulnerable to ozone-related health impacts.[36] Additionally, studies indicate that ozone increases more in already-polluted areas, making residents of cities more vulnerable to future impacts from climate change.[37]

The levels of fine particulate matter (PM2.5) in the air may increase as temperature and humidity increase. Inhalation of particulate matter can cause a range of negative health impacts, including coughing and difficulty breathing, chronic bronchitis, heart attack, arrthymias, decreased lung function, and aggravated asthma. People with existing heart and lung diseases, as well as children and older adults, are more susceptible to the effects of PM2.5. As with ozone and heat stress, outdoor workers are more vulnerable due to increased exposure.[38]

"Analyses of measured air quality data for New Jersey clearly show that increases in both particulate matter (PM2.5) and ozone can exceed national air quality standards during high electricity demand days, such as the heat wave of July 2006. These measurements (as seen in Figures 1 and 2) correspond to regional power generation that includes putting diesel and coal fired power plants temporarily on-line to supplement the regional power grid to address high energy demand."[39]

Climate change has caused the spring pollen season to begin earlier, and some studies also indicate that "increased temperatures and CO2 concentrations could increase the production of ragweed pollen and prolong the ragweed pollen season."[40] This may in turn affect pollen abundance and potency.[41] These factors are likely to result in increased prevalence of allergenic diseases such as allergic rhinitis.[42] Extreme rainfall and rising temperatures can also foster the growth of indoor fungi and molds, with increases in respiratory and asthma-related conditions.[43]

Storm-Related Injuries and Stresses

The intensity of extreme storm events is already increasing and is projected to increase further.[44] Extreme weather events may include hurricanes, floods, wildfires, and drought. There are a number of health impacts, both direct and indirect, that are likely to result from this climate trend.

The most obvious health impact of extreme weather events is direct morbidity and mortality, generally resulting from "blunt trauma, crush-related injuries, or drowning." Around 2,544 people died in the United States or its coastal waters from tropical cyclones in the 50-year period of 1963 to 2012. Approximately 90% of these deaths occurred in water-related incidents, mostly drowning.[45] The death toll in New Jersey as a result of Hurricane Sandy was 34; total death toll from the storm

34 USCCSP (2008)
35 Confalonieri (2007)
36 USCCSP (2008)
37 USGCRP (2009)
38 USCCSP (2008)
39 Carlton and Farkas (2012)
40 USCCSP (2008)
41 Bielory, Lyons and Goldberg (2012)
42 USCCSP (2008)
43 USGCRP (2013)
44 USGCRP (2013)
45 Rappaport (2013)

was 117.[46] Indirect impacts on physical health as a result of extreme weather events include carbon monoxide poisoning from generator use following power outages, mold and mildew exposure once residents return home after flooding, and an increase of stomach and intestinal illness among people displaced by disaster.[47] There is also the risk of direct physical damage to health care facilities and infrastructure, which reduces capacity to address public health needs.

Extreme weather events act as repetitive stressors and more frequent storms and floods are likely to lead to an increased incidence of mental health disorders, particularly anxiety, depression, and post-traumatic stress disorder.[48] Communities are often unprepared to deal with the mental-health impacts of weather-related disasters. In the wake of Hurricane Katrina, half of the respondents to a needs-assessment survey conducted by the CDC indicated a need for mental health care, but only 1.6 percent were actually being treated for mental health disorders.[49]

Infectious Diseases

As temperatures and humidity rise, certain vector-borne and zoonotic diseases are expected to expand their ranges, including the tick-borne Lyme disease, ehrlichiosis, babesiosis, Powassan, and Rocky Mountain spotted fever, rodent-borne hantavirus, and mosquito-borne diseases such West Nile virus and Eastern and Western equine encephalitis.[50] The range of the Asian tiger mosquito, an invasive species with high vector disease potential, continues to expand further north in the Northeastern United States; by the end of the century approximately 30 million Americans will live in areas at risk of dense Asian tiger mosquito infestations.[51] The Asian tiger mosquito is a primary vector for dengue and chikungunya fevers, the latter of which is a emerging disease in the Caribbean that has shown rapid transmission potential.[52] Studies indicate that warmer winters in Europe have allowed the Bluetongue virus, carried by midges, to better persist through the winter, posing a health threat to livestock and wildlife that would have repercussions for public health.[53] Dengue fever may also expand in range, but experts view the risk of increased incidences of dengue in the United States to be fairly low due to high-quality housing and medical infrastructure available in this country.[54]

An increase in extreme weather events increases the risk of contracting food- and water-borne diseases. "Heavy rain and flooding can contaminate certain food crops with feces from nearby livestock or wild animals, increasing the likelihood of food-borne disease associated with fresh produce."[55] Flooding also increases the likelihood of drinking contaminated water, leading to an increased incidence of gastrointestinal illness. The waterborne *Cryptosporidium* and *Giardia* parasites tend to increase in the aftermath of heavy downpours, putting recreational swimmers at higher risk of gastroenteritis.[56] Power outages resulting from severe weather events increase the likelihood of consuming spoiled food.

Cases of food poisoning due to *Salmonella* have been shown to increase with increasing air temperatures, making it likely that increased average temperatures and more frequent heat waves will result in more cases of salmonella. *Vibrio*, the pathogen responsible for shellfish poisoning, shows a similar positive relationship with warmer temperatures; from 1996 to 2006, the U.S. infection rate increased by 41 percent. The *Campylobacter* bacteria, responsible for 29% of water-borne outbreaks, has shown a positive but less conclusive relationship with rising temperatures. Increasing temperature may increase the range of *leptospirosis*, a currently rare bacterial infection typically transmitted through urine-contaminated water, while increasing precipitation and run-off makes transmission of *leptospirosis* more

[46] Centers for Disease Control (2013)
[47] USCCSP (2008)
[48] USGCRP (2013)
[49] Weisler, Barbee and Townsend (2006)
[50] USCCSP (2008), Centers for Disease Control (2013a)
[51] Rochlin et al. (2013)
[52] Fonseca (2014)
[53] Purse, Mellor and Rogers (2005)
[54] USCCSP (2008)
[55] USGCRP (2009)
[56] USCCSP (2008)

Table 1: New Jersey Impacts and Risk for Public Health as a result of climate change

Climate Impacts	*New Jersey Risks*
Heat-Related Illness	• Increase in heat related mortality and hospitalization from heat stress • Exacerbation of existing chronic conditions such as cardiovascular and respiratory disease conditions.
Air Quality Conditions	• Increase in pulmonary and respiratory diseases, particularly in urban areas, due to higher levels of ground level-ozone and fine particulate matter associated with higher temperatures and increased energy use during high temperature periods • Increase in asthma and allergenic diseases due to a longer pollen season and greater potency of pollen.
Storm-Related Injuries and Stresses	• Morbidity and mortality due to falling trees, drowning, and carbon monoxide poisoning from generators. • Increased mental health issues caused by repeated stressors • Consumption of contaminated food and water as a result of flooding, power outages, and displaced populations. • Damage to low-lying health care facilities and infrastructure • Exposure to mold, mildew, and toxic contamination from flooding, including flooding of hazardous or contaminated sites • Lack of availability of medications and medical equipment as a result of power outages and business closures.
Infectious Diseases	• Expanded ranges of vector-borne diseases such as Lyme disease, and West Nile virus • Increase in food-borne pathogens such as salmonella and vibrio caused by warming temperatures • Flood-related increases in population of waterborne parasites such as Cryptosporidium and Giardia, which cause gastroenteritis.

likely.[57] A general challenge posed by food and water-borne diseases is that these incidences tend to be highly underreported, making recognition of disease patterns and administration of proper treatment more difficult for the public health sector.

Particularly Vulnerable Groups

Given the potential effects of climate change on public health, certain subpopulations have been identified which are more vulnerable to the impacts of a changing climate.[58]

- Elderly persons, who are more susceptible to heat related diseases, are more likely to have pre-existing conditions, and have less mobility in the event of extreme weather events;
- Lower-income populations that may have less access to health care, quality housing, and other resources.

[57] USCCSP (2008)
[58] USCCSP (2008)

- Children, who are more sensitive to heat and air pollution and are more vulnerable to food and water borne diseases because of their immature immune systems
- People with chronic conditions that may be exacerbated by climate-related stressors
- People with mobility and cognitive constraints are more vulnerable to extreme weather events such as flooding or heat waves.
- Occupational groups that spend more time outdoors and are therefore more impacted by climate related stressors, particularly air quality.
- Immigrant and low English proficiency populations that may be less aware of government programs and warnings, and have smaller social networks to provide support.

New Jersey Specific Risks and Impacts

In the coming decades, New Jersey can expect an increase in average annual temperature and precipitation, with more rain in the winter. More intense extreme weather events are anticipated, including heat waves, hurricanes, and extreme precipitation events with subsequent flooding. New Jersey is also at risk of more frequent and severe coastal flooding due to sea level rise. Specific risks from these changes on public health in New Jersey are discussed below.

Heat-Related Illnesses

Data for 1999 and 2002, two of the hottest summers on record in New Jersey, are instructive. In 1999, there were 30 cases of heat-related mortality and in 2002 there were 18.[59] "Each year more than 1,200 persons are treated in New Jersey emergency departments for heat-related illness or sunburn, and overexposure to summer heat causes between 45 and 170 hospitalizations in New Jersey annually. The majority of those hospitalized in New Jersey are male, ages 65-84, and are hospitalized for 3 or more days."[60] Cooling centers in New Jersey are operated by municipalities.[61] While resources such as nj211.org compile lists of open cooling centers statewide, it is not clear there is statewide coordination and whether lessons learned are shared among operators of such centers.

With nearly 14% of its population over age 65, 45,000 of whom live in nursing facilities,[62] and 9.1% of its population in poverty,[63] New Jersey has a large population that is vulnerable to heat stress. According to the U.S. Census, "New Jersey is the most heavily urbanized state, with 92.2 percent of its population residing within urbanized areas of 50,000 or more,"[64] making the urban heat island effect especially relevant to public health in New Jersey. New Jersey has several cities with concentrations of low-income residents, such as Newark, Camden, and Patterson. However, the local health departments in some of these areas have strong outreach programs, whereas the public health infrastructure may not be as well developed in suburban areas. Additionally, elderly residents in suburban areas who do not have access to cars and do not have family members living nearby may be at risk during heat waves.

Additionally, the foreign-born population of the state continues to increase, with 21% of New Jersey's population made up of immigrants in 2010.[65] With over 30 languages spoken in the state, any outreach efforts aimed at reducing heat-related morbidity and mortality must take this diversity into account and target populations appropriately.

Air Quality Conditions

Many of the populations that are most vulnerable to heat stress are also the most likely to experience negative health outcomes related to poor air quality, particularly children and low-income residents in urban areas. In

[59] NJ Department of Health and Senior Services (2008b)
[60] NJ Department of Health and Senior Services (2008b)
[61] NJ Department of Health and Senior Services (2008b)
[62] Kaiser Family Foundation (2012a, 2012b)
[63] U.S. Census Bureau (2010)
[64] U.S. Census Bureau (2010)
[65] Migration Policy Institute, Migration Data Hub (2012)

its 2012 'State of the Air' Report Card of New Jersey, the American Lung Association ranked the air quality of 13 counties in New Jersey based on the number of high ozone days per year. Two counties received Ds and the other thirteen all received Fs,[66] indicating that air quality throughout New Jersey is already a health problem. The New York-Newark-Bridgeport area and the Philadelphia-Camden-Vineland Area ranked as the 15th and 16th most polluted metropolitan areas in the country, respectively.[67] Outdoor workers, which include laborers employed in agriculture, construction, maintenance, and repair, make up nearly 10% of New Jersey's workforce.[68] People employed in these occupations are at greater risk of negative health impacts from increased ozone and particulates due to their greater level of exposure.

Asthma prevalence statewide is 8% among adults and 10% among children. Among adults, blacks have the highest prevalence rate at 10%; hospitalizations due to asthma were 3 times higher among blacks than whites from 2000-2005, with the highest rate of hospitalizations in Essex, Hudson, Passaic, Mercer, Camden, Cumberland, and Atlantic counties.[69] Of 1.2 million annual admissions to acute care hospitals, 60,000 list asthma as the primary diagnosis.[70] Research indicates that increases in the levels of pollen in the air result in more asthma-related hospital admissions among children.[71] An estimated 15% of children in New Jersey have asthma, 69% of whom suffer from it chronically.[72] A longer pollen season in New Jersey is already putting people at increased risk of allergic disorders. Coupled with the warming effects of climate change, which may cause increased pollen counts and potency, it is anticipated that asthma and allergy-related hospital admissions are likely to increase in New Jersey, especially among children.[73]

Storm-Related Injuries and Stresses

Hurricane Sandy demonstrated the wide range of health impacts that can result from widespread flooding and power outages. Acute storm-related issues include direct morbidity and mortality from drowning, downed trees, and carbon monoxide poisoning, food and water contamination in the wake of storm events, and lack of availability of medicines and medical equipment as a result of power outages and business closures. Chronic issues resulting from storm events include mental health impacts and the health effects of mold exposure.[74]

According to the New Jersey Department of Environmental Protection, approximately 35 percent of New Jersey residents live in floodplains.[75] New Jersey has been declared a disaster area 35 times since 1955; 10 of these declarations have occurred from 2010-2012.[76] Flooding also puts communities at health risk from water contamination caused by combined sewer overflows; New Jersey has 217 combined sewer outfalls in 21 communities, including Jersey City and Newark.[77]

Infectious Diseases

New Jersey has a statewide Infectious and Zoonotic Disease Program under the Communicable Disease Service. Health providers use the Communicable Disease Reporting and Surveillance System (CDRSS), a web-enabled electronic system, to report communicable diseases to Local Health Departments. Many of the diseases that could become more common as a result of climate change, including hantavirus, food-borne illnesses, Rocky Mountain spotted fever, salmonellosis, giardasis, and Lyme disease, are already required to be reported to Local Health Departments within 24 hours of diagnosis.[78] The New Jersey Department of

[66] American Lung Association (2012a)
[67] American Lung Association (2012b)
[68] Bureau of Labor Statistics (2011)
[69] New Jersey Department of Health and Senior Services (n.d.): NJ Asthma Strategic Plan 2008-2013
[70] Im and Schneider (2005)
[71] Im and Schneider (2005)
[72] New Jersey Department of Health and Senior Services (2008c)
[73] Bielory, Lyons and Goldberg (2012)
[74] NJCAA (2013)
[75] Association of New Jersey Environmental Commissions (2009)
[76] FEMA (n.d.)
[77] NJDEP (2013)
[78] New Jersey Department of Health and Senior Services: Disease Reporting Requirements (2012c)

Environmental Protection issued a warning in September 2012 alerting the public about an outbreak of epizootic hemorrhagic disease (EHD) virus among the state's deer population; the first reported outbreak of EHD in New Jersey was in 2007.[79] Though EHD is not transmissible to humans, it signals the importance of tracking non-endemic diseases that may increase in prevalence.

Benchmark Adaptation Practices

New Jersey has not yet developed a statewide plan for adapting to the impacts of climate change. In the short term, climate change may not create new public health issues but rather will exacerbate existing issues. While many of these health issues are addressed by existing agencies such as the state Communicable Disease Service and the Office of Emergency Management, no formal statewide assessment has been conducted to evaluate the adequacy of existing public health institutions to adapt to climate change.

The CDC created a framework to help public health agencies develop climate change adaptation strategies, known as the Building Resilience Against Climate Effects (BRACE) framework.[80] This framework identifies a five step process that states should undertake to prepare for the impacts of climate change:

1. Forecast climate impacts and assess vulnerabilities
2. Project the disease burden
3. Assess public health interventions
4. Develop and implement a Climate & Health Adaptation Plan that addresses health impacts, gaps in critical public health functions/services, and formulates a plan for enhancing adaptive capacity in the jurisdiction.
5. Evaluate adaptation efforts

Several states have developed climate change adaptation plans with a specific focus on human health under the CDC's Climate Ready States and Cities Initiative, including New York, Minnesota,[81] Michigan,[82] Massachusetts, and Maryland. For the most part, these adaptation plans have been developed over the last two years, so while they provide a number of policy and planning recommendations that can be considered for New Jersey, there are few examples discussed below that have been implemented yet.

New York State's Climate Action Plan identifies a number of policy options to incorporate climate change into public health planning. To address heat related morbidity and mortality, recommendations include assessing the adequacy of existing heat warning systems, expanding the capacity of cooling centers, and developing a statewide "Green Cool-down Plan" to reduce the heat island effect. New York recommends that public health impacts of climate change should be considered in all policies, plans, programs, and regulations. Both the state Climate Action Plan and New York City's PLANYC place a particular focus on supporting healthy built environments. New York notes the need to better educate the public on health consequences of climate change, with a focus on enhancing existing outreach programs to target vulnerable populations. New York also identified the need to evaluate and enhance existing disease surveillance and emergency preparedness programs.[83] To address the needs of high risk populations during heat waves, New York State gives away free air conditioners to qualifying residents through its Home Energy Assistance Program.

New York City's "A Stronger, More Resilient New York" report, written to address the need for additional coastal resiliency planning following Hurricane Sandy, includes localized climate change projections and a risk assessment of how these changes will impact the city's residents. It includes a series of recommendations to improve the resiliency of the city's health system, including requiring retrofitting of hospitals in the 500-year floodplain and nursing home and adult care

[79] NJDEP (2012)
[80] Centers for Disease Control and Prevention (2012b)
[81] Minnesota Department of Health (2010)
[82] Michigan Department of Community Health (2011)
[83] New York State Climate Action Council (2010)

facilities in the 100-year floodplain, increasing the air conditioning capacity of nursing home and adult care facilities, improving pharmacies' power resiliency, and expanding Community Emergency Response Teams.[84]

Like New York, Maryland's Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change emphasizes the importance of integrating human health concerns with the planning processes and programs of the "non-health" community. Maryland's plan identifies a need to assess the existing capacity to gain a better understanding of the public health sector's ability to respond to climate-related impacts using existing programs for preventive measures, emergency response, and food supply safety. Maryland's plan suggests expanding the capacity of vector-borne disease surveillance and control programs, improving the availability and dissemination of health and population data, and creating risk maps of vulnerable areas and populations. Maryland also emphasizes the importance of community engagement, public awareness campaigns, and outreach targeted to at-risk populations.[85]

Massachusetts divides its recommendations up into short and long term strategies. Short term strategies include identifying vulnerabilities, assessing the capacity of existing providers, promoting education campaigns, automating and streamlining data reporting mechanisms, and stockpiling supplies for prevention of vector-borne diseases. Over the longer term, Massachusetts' suggestions include: enhancing coordination among local boards of health by regionalizing, considering the development of a systematic tick surveillance program statewide to monitor vector densities and infection rates and otherwise expanding disease surveillance capacity, involving community groups to do local outreach on climate risks and personal prevention practices, facilitating monitoring of currently non-endemic diseases, and developing plans to relocate vulnerable health care facilities located in floodplains.[86]

Minnesota's Department of Health has developed maps illustrating various types of social vulnerability along with a toolkit for responding to extreme heat. This toolkit includes instructions for communities to develop extreme heat response plans as well as access to data portals. Minnesota's Department of Health also has a website that provides planning tools, webinars and educational materials to the general public. The website includes training modules on how climate change could affect mental health, food security and, extreme heat, as well as a 26-minute instructional video about climate change and health.[87]

At the city level, Philadelphia's Heat Watch program is widely cited as an example of an effective heat warning program. This coordinated outreach program uses a buddy system to check on elderly residents, operates a "Heatline" staffed by nurses, facilitates access to cooling centers, coordinates with block captains to, and increases the numbers of EMS staff on duty.[88]

A method in which to visualize potential climate impacts to human health is the Geospatial Emergency Management Support System (GEMSS). This protocol uses spatial analysis and mapping at the census block level to identify areas within a municipality that may have higher social and infrastructure vulnerabilities to the effects of climate change, including extreme heat and extreme precipitation events. GEMSS was implemented in Austin and Travis County, Texas as part of a pilot project funded through the CDC. Early results found specific neighborhoods that may be more vulnerable to extreme heat and extreme precipitation. The study also linked four potential policy solutions during the initial phase of the project.[89]

A number of themes, strategies, and recommendations for the public health sector have emerged that are similar from state to state:

1. Assess vulnerabilities and risks, and evaluate capacity of existing public health programs and infrastructure to deal with these impacts

[84] PlaNYC (2013)
[85] Maryland Commission on Climate Adaptation and Response (2011)
[86] Massachusetts Executive Office of Energy and Environmental Affairs and Adaptation Advisory Committee (2011)
[87] Minnesota Department of Health. Climate and Health (2014)
[88] USGCRP (2009)
[89] Houghton, et al. (2012)

2. Integrate health planning with the planning practices of other sectors, particularly land use, infrastructure, and transportation planning.
3. Enhance capacity of existing programs, such as data collection, disease surveillance, emergency response, and heat-watch programs.
4. Increase education and outreach efforts, with specific emphasis on encouraging preventive practices and reaching vulnerable populations.

Discussion and Recommendations

Public health in New Jersey is managed through a number of different agencies at different levels of government. Coordination and dissemination of information among the various agencies and their constituent stakeholder groups is therefore critical to ensure input into any planning processes and assure that all relevant stakeholders work together to fully implement adaptation strategies.

Climate change will adversely affect public health in New Jersey by stressing the capacities of the existing public health infrastructure. Research predicts that climate change will result in increased incidences of heat stress, asthma, allergies, and food, water, and vector-borne diseases, along with increased morbidity and mortality resulting from extreme weather events. Many of these impacts are already public health issues but could become greater issues as our climate changes. Other states have developed strategies for adapting to some of these concerns. New Jersey should move forward by focusing on the following groups of initiatives:

Assess vulnerability and existing capacity: It is critical to acquire a detailed understanding of where the risks and vulnerabilities are in the state and to assess how well equipped New Jersey's current public health infrastructure is to address these risks. While this report provides a very general overview of the health risks associated with climate change, more detailed assessment is required. Risk maps should be prepared for areas most likely to be affected by flooding, increased pathogens and air quality in order to assess the disease burden, and vulnerable populations should be identified and located. A thorough review should be conducted of existing emergency preparedness and response plans, disease surveillance programs, data collection and sharing capacities, cooling center availability, allergy and asthma programs, message dissemination processes, et cetera, in order to identify gaps in public health functions and services, as well as gaps in ability to track health outcomes. Once this assessment is completed, specific policy recommendations and strategies to build capacity can be identified, as has been done in other states.

Integrate climate adaptation for public health with existing planning and regulatory processes: Some states and regions have been successful at incorporating climate change into official planning processes while others have not. Many states identify the need to incorporate planning for public health with planning for infrastructure, transportation, and the built environment. Several states' climate and health adaptation strategies include a host of recommendations for land use, transportation, utilities, and natural resource management that have substantial co-benefits for public health. As New Jersey moves forward, public health and healthcare providers and regulators should be required to incorporate climate change adaptation into their strategic plans, programs and capital planning efforts. Additionally, it is critical for the state to better coordinate amongst the many agencies and organizations that are responsible for public health in New Jersey.

Review and revise regulations: A review of relevant regulations should be conducted to identify where changes could or should be made that would facilitate climate adaptation. For example, it is important that the state regularly updates disease reporting requirements to ensure that currently non-endemic diseases that may increase in prevalence are appropriately tracked. Because current reporting in most cases is to the LHDs, rather than directly to DOH, statewide coordination of surveillance and investigation is critical in order to better identify and treat disease outbreaks. Other regulations that should be examined include food and water handling regulations, statewide sewerage codes, and heat action levels for heat advisories.

Conduct education, outreach, and training programs: Leading practitioners in other states emphasize the need for public engagement on many levels. A broad awareness campaign is recommended to raise awareness about the health impacts of climate changes amongst government officials, public health professionals, health care providers, and the general public. Additionally, it is important to educate the public regarding personal preventive practices that can be taken to mitigate the negative health impacts of climate change. Special emphasis should be placed on targeting outreach materials at vulnerable populations, and critically assessing how successful past outreach efforts were so they can be improved upon. Community organizations should be engaged to assist with planning and outreach. Finally, New Jersey should consider implementing workforce development programs to ensure that health professionals are adequately trained to deal with climate-related health impacts.

Table 2: Specific areas for investigation based on leading practices and recommendations

New Jersey Adaptation Need	*Potential Initiatives for Investigation and Projects*
Assess vulnerability and existing capacity	• Review existing emergency preparedness and response plans and identify areas needing improvement. • Prepare risk maps for areas most likely to be affected by flooding, increased pathogens, air quality, etc. Assess likely disease burden. • Identify and locate vulnerable populations. • Analyze risks to public health infrastructure. • Assess data gaps and limitations to gathering data and tracking health outcomes.
Integrate climate adaptation with existing planning and regulatory processes	• Investigate methods to account for climate change and adaptation planning as a required element of master plans. • Implement Green Cities' measures such as planting trees and promoting smart growth, which have co-benefits for public health. • Impose more stringent regulations on emission of greenhouse gases in order to improve air quality. • Coordinate with utilities during the infrastructure planning process to upgrade water supply and sewerage treatment systems. Ensure utilities have adequate infrastructure to prevent power outages during extreme heat waves. • Make reducing vector breeding grounds a goal of ecosystem management programs.
Review and revise regulations	• Review heat action levels Modify food & water handling regulations. • Ensure reporting requirements are in place for currently non-endemic diseases. Ensure data is shareable across jurisdictional boundaries. • Review water policy, laws and regulations; e.g. statewide sewerage codes and analyze changes that may be beneficial to public health • Require emergency response plans to include coordination among local health departments, businesses, utilities, governments, and community organizations.
Conduct education, outreach, and training programs	• Educate the general public, public health professionals, health care providers, government officials, businesses, etc. about the health impacts associated with climate change. • Increase awareness among the general public and the public health community about personal preventive practices and preparedness measures. • Implement workforce development programs to ensure that health professionals are adequately trained to deal with climate-related health impacts. • Engage community organizations in planning for extreme weather events, conducting outreach programs, and working with vulnerable populations. • Target outreach materials to vulnerable populations. Evaluate results of past programs to understand how effective communications efforts were and how better compliance with early warnings can be achieved. • Incorporate telecommunications and social networking into early warning and evacuation systems.

Sources

American Lung Association. 2012a. State of the Air 2012. Report Card: New Jersey. Available at *http://www.stateoftheair.org/2012/states/new-jersey/* .

American Lung Association. 2012b. State of the Air 2012. Most Polluted Cities. Available at *http://www.stateoftheair.org/2012/city-rankings/most-polluted-cities.html*.

Association of New Jersey Environmental Commissions. 2009. Water Resources: Flood Hazard Area Regulations. Available at *http://www.anjec.org/WaterFloodHazardAreaRegs.htm*.

Basu, R., F. Dominici, and J.M. Samet. 2005: Temperature and mortality among the elderly in the United States: a comparison of epidemiologic methods. Epidemiology. 16(1), 58-66.

Bielory L, K. Lyons, and R. Goldberg. 2012. Climate change and allergic disease. Curr. Allergy Asthma Rep. December. 12(6):485-94. doi: 10.1007/s11882-012-0314-z. PMID: 23065327 [PubMed - in process]

Brikowski, T.H., Y. Lotan, and M.S. Pearle. 2008. Climate-related increase in the prevalence of urolithiasis in the United States. Proceedings of the National Academy of Sciences, 105(28), 9841-9846.

Broccoli, A., Kaplan, M., Loikith, P., and Robinson, D. 2013. State of the Climate: New Jersey. Rutgers Climate Institute. Available at: *http://climatechange.rutgers.edu/resources/state-of-the-climate-new-jersey-2013*.

Bureau of Labor Statistics. 2011. May 2011 State Occupational Employment and Wage Estimates: New Jersey. Available at *http://www.bls.gov/oes/current/oes_nj.htm*.

Carlton, Annmarie and Caroline Farkas. October 29, 2012. Rutgers University Department of Environmental Sciences, personal communication.

Centers for Disease Control and Prevention. 2012a. NIOSH Workplace Safety and Health Topics. Heat Stress. Available at *http://www.cdc.gov/niosh/topics/heatstress/*. Accessed Nov 12, 2012.

Centers for Disease Control and Prevention. 2012b. CDC's Building Resilience Against Climate Effects (BRACE) Framework. Available at *http://www.cdc.gov/climateandhealth/BRACE.htm*.

Centers for Disease Control and Prevention (CDC). 2013. Deaths Associated with Hurricane Sandy – October-November 2012. Available at: http://www.cdc.gov/mmwr/ preview/mmwrhtml/mm6220a1.htm.

Centers for Disease Control and Prevention (CDC). 2013a. Tickborne Diseases of the United States: A Reference Manual for for Health Care Providers. Available at *http://www.cdc.gov/lyme/resources/TickborneDiseases.pdf*.

Confalonieri, U., B. Menne, R. Akhtar, K.L. Ebi, M. Hauengue, R.S. Kovats, B. Revich, and A. Woodward. 2007. Human health. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Available at *http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter8.pdf*.

Federal Emergency Management Agency (FEMA). n.d. DHS. Declared Disasters by Year or State. n.d. Available at *http://www.fema.gov/disasters/grid/state/37?field_disaster_type_term_tid_1=All*.

Fonseca, Dina. 2014. Rutgers University Department of Environmental Sciences, personal communication.

Holleran. 2009. State Public Health System Performance Assessment for New Jersey. December 18, 2009. Available at *http://www.state.nj.us/health/lh/documents/njsphsa_holleran.pdf*.

Houghton, A., N. Prudent, , J.E. Scott, R. Wade, and G. Luber. 2012. Climate change-related vulnerabilities and local environmental public health tracking through GEMSS: A web-based visualization tool. Applied Geography (33). 36-44.

Im W. and D. Schneider. 2005. Effect of weed pollen on children's hospital admissions for asthma during the fall season. Archives of Environmental & Occupational Health, 60(5): 257-65.

Kaiser Family Foundation. 2012a. Data Source: Urban Institute and Kaiser Commission on Medicaid and the Uninsured; estimates based on the Census Bureau's March 2011 and 2012 Current Population Survey (CPS: Annual Social and Economic Supplements). Accessed Nov 12, 2012 at *http://www.statehealthfacts.org*.

Kaiser Family Foundation. 2012b. statehealthfacts.org. Data Source: 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, and 2010 AHA Annual Survey Copyright 2012 by Health Forum LLC, an affiliate of the American Hospital Association, special data request, April 2012. Available at *http://www.ahaonlinestore.com. Accessed Nov 12, 2012 at http://www.statehealthfacts.org/profileind.jsp?cat=8&rgn=32*.

Kaiser Family Foundation. 2012c. statehealthfacts.org. Data Source: C. Harrington, H. Carrillo, M. Dowdell, P. Tang, and B. Blank. Table 1, "Nursing, Facilities, Staffing, Residents, and Facility Deficiencies, 2005 Through 2010," Department of Social and Behavioral Sciences, University of California, San Francisco, accessed January 2012. Available at *http://www.pascenter.org*. Based on the Online Survey, Certification, and Reporting system (OSCAR), Centers for Medicare and Medicaid Services, U.S. Department of Health and Human Services. Accessed Nov 12, 2012 at *http://www.statehealthfacts.org/profileind.jsp?cat=8&sub=97&rgn=32*.

Kaiser Family Foundation. 2012d. statehealthfacts.org. Data Source: National Association of Community Health Centers, Incorporated (NACHC) analysis of the 2010 Uniform Data System, Bureau of Primary Health Care, Health Resources and Services Administration, Department of Health and Human Services, Special Data Request, November 2011. Accessed Nov 12, 2012 at *http://www.statehealthfacts.org/profileind.jsp?ind=424&cat=8&rgn=32*.

Luber, G.E. and L.M Conklin. 2006. Heat-related deaths: United States, 1999–2003. Morbidity and Mortality Weekly Report, 55(29): 796-798. Available at *http://www.cdc.gov/MMWR/preview/mmwrhtml/mm5529a2.htm*.

Maryland Commission on Climate Change Adaptation and Response. 2011. Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change. Phase II: Building societal, economic, and ecological resilience.

Massachusetts Executive Office of Energy and Environmental Affairs and Adaptation Advisory Committee 2011. Massachusetts Climate Change Adaptation Report.

Michigan Department of Community Health. 2011. Michigan Climate and Health Adaptation Plan: 2010-2015 Strategic Plan.

Migration Policy Institute, MPI Data Hub. 2012. New Jersey Social and Demographic Characteristics. Data Source: US Census Bureau, 2010 American Community Survey (ACS); US Census Bureau, 1990 Census of Population and Housing and Census 2000. Available at *http://www.migrationinformation.org/datahub/state.cfm?ID=nj*.

Minnesota Department of Health. 2010. Draft MDH Strategic Plan to Adapt to Climate Change. August. Available at *http://www.health.state.mn.us/divs/climatechange/docs/mdhspacc.pdf*.

Minnesota Department of Health. 2014. Climate and Health. Accessed March 17, 2014. Available at *http://www.health.state.mn.us/divs/climatechange/index.html*.

New Jersey Climate Adaptation Alliance (NJCAA). 2013. Resilience. Preparing New Jersey for Climate Change: A Gap Analysis from the New Jersey Climate Adaptation Alliance. Edited by Matt Campo, Marjorie Kaplan, Jeanne Herb. New Brunswick, New Jersey: Rutgers University. Available at *http://njadapt.rutgers.edu/resources/njcaa-reports*.

New Jersey Commission on Rationalizing Health Care Resources. 2008. Final Report. Available at *http://www.nj.gov/health/rhc/finalreport/documents/entire_finalreport.pdf*.

New Jersey Department of Environmental Protection (NJDEP). 2012. Sept 18. Public Advised to be Alert for New Jersey Deer That May Have EHD Virus; Disease Cannot be Transmitted to People. Available at *http://www.nj.gov/dep/newsrel/2012/12_0105.htm*.

New Jersey Department of Envrionmental Protection (NJDEP). 2013. Combined Sewer Outfall (CSO) Individual NJPDES Discharge Permits - FAQs 2013. Available at: *http://www.nj.gov/dep/dwq/pdf/cso_faqs_062113.pdf*.

New Jersey Department of Health (NJDOH). 2013. Directory of Local Health Departments in New Jersey. Available at: *http://www.state.nj.us/health/lh/documents/lhdirectory.pdf*.

New Jersey Department of Health and Senior Services.n.d. New Jersey Asthma Strategic Plan 2008-2013. Available at *http://www.state.nj.us/health/fhs/asthma/documents/asthma_strategic_plan2008-2013.pdf*.

New Jersey Department of Health and Senior Services. n.d. Responding to Public Health Emergencies: New Jersey's Strategy. Available at *http://www.nj.gov/health/response/documents/responding_phe.pdf*.

New Jersey Department of Health and Senior Services. 2008a. A Study of New Jersey's Local Public Health System. Available at *http://www.state.nj.us/health/lh/documents/study_report.pdf*.

New Jersey Department of Health and Senior Services. 2008b. Health Data Fact Sheet: Beat the Heat! Avoid Heat-Related Illnesses, 2008. Available at: *http://www.state.nj.us/health/chs/monthlyfactsheets/heat.pdf*.

New Jersey Department of Health and Senior Services. 2008c. Health Data Fact Sheet: May is Asthma Awareness Month, May 6 is Asthma Awareness Day. Available at *http://www.nj.gov/health/chs/monthlyfactsheets/asthma.pdf*.

New Jersey Department of Health and Senior Services.2012a. Press Release: DOH Urges Residents to Avoid Dangers of Extreme Heat, May 29, 2012. Available at: *http://www.state.nj.us/health/news/2012/approved/20120529a.html*.

New Jersey Department of Health and Senior Services. 2012b. Communicable Disease Service. "Infectious and Zoonotic Disease Program". Available at *http://www.state.nj.us/health/cd/izdp/index.shtml*.

New Jersey Department of Health and Senior Services. 2012c.Disease Reporting Requirements/Regulations. Available at *http://www.state.nj.us/health/cd/reporting.shtml*.

New Jersey Department of Health and Senior Services. 2012d.Office of Local Public Health. Government Public Health Partnerships. Available at *http://www.state.nj.us/health/lh/gphp.shtml*.

New Jersey Department of Health and Senior Services. 2012e. PHILEP. Available at *http://www.state.nj.us/health/response/index.shtml*.

New Jersey Department of Health and Senior Services. 2012f. Office of Local Public Health. Public Health in NJ. Available at *http://www.state.nj.us/health/lh/nj.shtml*.

New York State Climate Action Council. 2012. Climate Action Plan Interim Report. November 2012.

N.J.S.A. 26:3A2-10.c. "Local Health Services Act". L.1975, c. 329, s. 1, eff. April 1, 1976.

Purse, B.V., P.S. Mellor, D.J. Rogers, A.R. Samuel, P.P. Mertens, and M. Baylis. 2005. Climate change and the recent emergence of bluetongue in Europe. Nature Reviews Microbiology, 3(2): 171-181.

Rappaport, E.N. 2013., Fatalities in the United States from Atlantic tropical cyclones – new data and interpretation, Bulletin of the American Meteorological Society. accepted for publication. Available at: *http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-12-00074.1*.

Robine, J. M., S. L. K. Cheung, S. Le Roy, H. Van Oyen, C. Griffiths, J. P. Michel, and F. R. Herrmann. 2008. Death toll exceeded 70,000 in Europe during the summer of 2003. Comptes Rendus Biologies 331 (2):171-175.

Rochlin, I., Ninivaggi, D., Hutchinson, M., Farajollahi, A. 2013. Climate Change and Range Expansion of the Asian Tiger Mosquito (Aedes albopicture) In Northeastern USA: Implications for Public Health Practitioners. PLoS ONE 8(4): e60874. doi:10.1371/journal.pone.0060874.

Schwartz, J. 2005. Who is sensitive to extremes of temperature? A case-only analysis. Epidemiology, 16(1): 67-72.

Semenza, J.C. 1999. Acute renal failure during heat waves. American Journal of Preventive Medicine, 17(1): 97.

United Health Foundation. 2011. America's Health Rankings: New Jersey Public Health Funding. Available at *http://www.americashealthrankings.org/NJ/PH_Spending/2011*. Accessed Nov 26, 2012.

U.S. Census Bureau. 2010. State & County Quickfacts: New Jersey. Retrieved November 16, 2012 from *http://quickfacts.census.gov/qfd/states/34000.html*.

U.S. Census Bureau. 2012. Newsroom: Growth in Urban Population Outpaces Rest of Nation, Census Bureau Reports. March 26, 2012. Available at *http://www.census.gov/newsroom/releases/archives/2010_census/cb12-50.html*. Accessed Nov 16, 2012.

U.S. Climate Change Science Program (USCCSP) .2008. Analyses of the effects of global change on human health and welfare and human systems. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. [Gamble, J.L. (ed.), K.L. Ebi, F.G. Sussman, T.J. Wilbanks, (Authors)]. U.S. Environmental Protection Agency, Washington, DC, USA.

U.S. Global Climate Change Research Program (USGCRP). 2009. Global Climate Change Impacts in the United States. Karl, T.R., J.M. Melillo, and T.C. Peterson (eds.). New York: Cambridge University Press. Available at: *http://globalchange.gov/publications/reports/scientific-assessments/us-impacts*.

U.S. Global Climate Change Research Program (USGCRP) 2013. Draft National Climate Assessment Report Available at: *http://ncadac.globalchange.gov/*.

Watson J.T., M.Gayer , and M.A. Connolly. 2007. Epidemics after natural disasters. Emerg Infect Dis [serial on the Internet]. January 2007. Available at h*ttp://wwwnc.cdc.gov/eid/article/13/1/06-0779.htm*. Accessed Nov 16, 2012.

Weisler, R.H., J.G.I. Barbee, and M.H. Townsend. 2006. Mental health and recovery in the Gulf coast after hurricanes Katrina and Rita. The Journal of the American Medical Association, 296(5): 585-588.