FACTORS THAT INFLUENCE STATE WRITTEN PANDEMIC FLU PLAN INCLUSION OF FEDERAL RECOMMENDATIONS

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ABSTRACT
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The threat of a pandemic influenza outbreak is considered imminent and could cause severe morbidity and mortality as well as devastating economic losses. The U.S. government has worked to empower states to respond to a pandemic, but there has been minimal evaluation to determine the success of such efforts. The purpose of this study was to examine states' preparedness for a pandemic as documented by states' written pandemic plans and evaluate what political and structural factors may be associated with pandemic plan inclusion of federal recommendations.

This was a cross-sectional comparative analysis of 50 states' pandemic influenza plans as of March 2008. The Centers for Disease Control and Prevention's (CDC) State and Local Pandemic Influenza Planning Checklist was turned into a matrix with each of 85 recommendations making up 10 overarching domains coded as "no mention" = 1, "brief mention but no description or action item" = 2, or "description or action of the item" = 3. Forty-nine complete plans and one state's plan summary were included in the analysis. Each state's domain scores were calculated by adding the scores of each factor within the domain. A "total preparedness score" for each state, was derived by adding the unweighted scores of each domain. Federal recommendations surrounding leadership, networking and surveillance have been well-integrated, but greater efforts are needed to develop partnerships with health care agencies and to focus on antiviral preparedness and infection controls.

Federal and state governments have invested resources in pandemic planning and published recommendations for such planning; however, little research has been conducted focusing on what predicts integration of federal recommendations in written state plans. Understanding the factors that influence state plans can offer health departments strategies for increasing their effectiveness in pandemic preparedness and response. This study compared models for bureaucratic behavior and health department structural variables to evaluate what factors may be associated with pandemic plans. The findings showed that structural variables offer greater explanation for pandemic plan comprehensiveness than political theory models, but more work is needed to glean causal relationships. Recommendations to assist state health departments, legislators, and responders in improving state pandemic plans are presented as well as suggested areas for future research.

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INTRODUCTION

Background

Pandemic influenza is a virulent flu of global dimensions with outbreaks that easily spread from person to person, and little if any immunity is present (Gingerich, 2006). World-wide disease outbreaks have occurred approximately 12 times in 400 years (Kuszewski & Brydak, 2000), and they have killed millions of people. Increased travel, global commerce, and the surfacing of novel viruses make pandemics a continuous threat to the morbidity and mortality of people around the globe. Based on the timing of previous pandemics, another outbreak is looming (Kuszewski & Brydak, 2000; Potter, 2001), and the international community is preparing for a worst-case scenario. Previous pandemics have taught us about the potential impact of such disease outbreaks and offer lessons learned about detection, surveillance, and response.

It is unknown when the first influenza pandemic occurred, but references to influenza can be found in scientific and lay publications since 1650 (Potter, 2001). Evidence of pandemics is present in records as early as 412 BC (Kuszewski & Brydak, 2000), and the historical record indicates a few features that make influenza epidemics more likely. Epidemics tend to occur in winter months when it is cold, people crowd tightly together, and humidity is increased. Pandemics are often first seen in Eastern or Southern Hemisphere countries and then spread to Europe and North America. Pandemics are also more likely to occur when a variant virus appears which shows antigenic changes from prior strains and cross-reacting antibodies are low (Potter, 2001).

Influenza viruses are grouped into types A, B, and C. Viruses of the C type are common and often cause no symptoms or mild respiratory illness. Type B viruses cause sporadic outbreaks of more severe respiratory disease, particularly among children in school. B and C viruses are essentially human viruses, but A and B viruses are those prone to mutation. Influenza A viruses mutate much more rapidly than type B viruses because they have a large number of subtypes which are maintained in aquatic birds. At recurring, yet unpredictable intervals, influenza A viruses cause pandemics (World Health Organization, 2005). The types of virus are distinguished by the antigentic properties of the virus: haemagglutinin (HA) and neuraminidase (NA). There are 15 types of haemagglutinin (1-15) and nine types of neuraminidase (1-9). The World Health Organization (WHO) uses this distinction to distinguish subtypes of influenza viruses (Kuszewski & Brydak, 2000). Monitoring antigenic variation in the influenza virus can assist in anticipating epidemics and vaccine design (Potter, 2001).

Two conditions must be satisfied for an influenza outbreak to be classified as a pandemic. First, the outbreak of infection spreads throughout the world from a specific geographical area causing a high percentage of individuals to be infected with elevated levels of mortality. Second, a pandemic is caused by a new influenza virus A subtype. Influenza A viruses undergo constant stepwise changes in their genetic make-up. These changes, known as antigenic drift, keeps populations susceptible to infection with rapid variation in genetic make-up. In order to be deemed a pandemic, the HA of the new subtype must not be related to that of other influenza viruses circulating immediately before the outbreak, and it cannot be a mutation of those viruses (Potter, 2001).

Immunity is primarily related to the antibody HA, and the appearance of a new virus subtype with different HA means immunity from past viruses, but it offers no protection from the new

strain, and the spread of infection is unchecked. The lack of protection from new strains is called antigenic shift (Potter, 2001). Antigenic shift is a long-term survival tactic for viruses as gene segments are swapped during co-infection with human and Avian Influenza viruses, creating new virus subtypes that will be entirely or largely unfamiliar to the human immune system. This new virus can cause severe disease and allow easy and sustainable human-to-human transmission igniting a pandemic (World Health Organization, 2005). Populations protected against one virus strain will not be protected when the next slightly different virus arrives; a new vaccine must be produced for each new influenza outbreak.

Influenza Pandemics – A History

Pandemics that have occurred in recent history, and the response to them, can help guide the preparation for a future pandemic. “Asian flu” was the last influenza pandemic of the nineteenth century and occurred between 1889 and 1890. The outbreak began in Russia in May of 1889 and spread slowly at first, then gained speed and spread rapidly to the West in only a few months. By the spring of 1890 the virus affected most of the world, and high morbidity and mortality were experienced everywhere (Kuszewski & Brydak, 2000). The “Asian flu” pandemic made clear how quickly such a disease could spread across continents during a time when international travel was rare.

The Spanish Influenza pandemic, also called the “Flu of 1918,” was the most catastrophic pandemic in recent history and is the event against which all modern pandemics are measured (United States Department of Health and Human Services, n.d.). It is not clear where the virus was initiated, but a highly virulent strain spread throughout Europe from northern and western French port cities where large numbers of American troops were transported (Potter, 2001). War censorship kept information about the illness from being publicized, but Spanish newspapers

published a story about the outbreak, and the name was attributed to that country (Kuszewski & Brydak, 2000). Approximately 20 to 40%o f the world's population became ill and over 50 million people died during the pandemic. Between September 1918 and April 1919, approximately 675 thousand people died in the U.S. alone. People perished quickly, sometimes within hours of illness onset.

The flu of 1918 was particularly unusual because of its ability to kill young, healthy adults. The reasons for this remain unclear, but the disease severity and magnitude of this outbreak has not occurred since (United States Department of Health and Human Services, n.d.). After the disappearance of the 1918 flu strain, milder flu epidemics occurred every few years, but none caused the devastation of the Spanish flu (Kuszewski & Brydak, 2000). In 1933, the influenza virus was discovered which resulted in the development of the first vaccine, injected into mice, in 1936 (Kuszewski & Brydak, 2000), but it was not until years later that vaccines were effective in people.

Another Asian influenza pandemic was first identified in the Far East in February 1957. Immunity to this strain was rare in people younger than 65 years of age, and rapid spread was predicted (United States Department of Health and Human Services, n.d.). Vaccine production began in late May 1957, and health officials increased surveillance for flu. The pandemic virus was quickly identified, and a vaccine was available in limited supply by August 1957. However, when U.S. children went back to school in the fall of 1957, they spread the disease in classrooms and brought it home to their families. Infection rates were highest among school children, young adults, and pregnant women in October 1957, but the elderly had the highest death rates. While the worst seemed to be over by December 1957, there was another wave in January and February 1958 among the elderly. In total, approximately 69,000 people in the US died of the Asian flu

(United States Department of Health and Human Services, n.d.), and it is estimated that this outbreak caused a million deaths world-wide (Kuszewski & Brydak, 2000).Vaccination may have reduced the spread of disease, but production was too limited to have a large impact on the incidence of illness.

In July 1968, the Hong Kong influenza pandemic was detected in China. The first cases in the U.S. were discovered as early as September, but illness did not become widespread until December. Those over the age of 65 were most vulnerable to the pandemic, and deaths from this virus peaked in December 1968 and January 1969. Almost 34 thousand people died between September 1968 and March 1969, making it the mildest pandemic in the 20th Century (United States Department of Health and Human Services, n.d.). The Hong Kong pandemic was different because this was the first time two virus subtypes circulated at once (Kuszewski & Brydak, 2000).

In 1976, the "killer flu" was named when a novel strain was first identified at Fort Dix, New Jersey. It was suspected that the virus was related to the Spanish Influenza virus of 1918, and concerns about the rapid spread of the virus led to a mass vaccination campaign in the United States. The "swine flu" never moved outside of the Fort Dix area and later research showed that if it had spread, it would have been much milder than the Spanish flu of 1918 (United States Department of Health and Human Services, n.d.). It is still debated whether the "swine flu" was an "actual" pandemic (Potter, 2001), but the rapid vaccination campaign offers a model for future pandemic response.

Since the early 21st Century, Avian Flu (H5N1) has been considered the most likely type of influenza to become a pandemic. Between March and May 1997, an epidemic of Avian Influenza broke out on industrial chicken farms in China. Eighteen people of differing ages became ill and

six people, aged 3-60, died (Kuszewski & Brydak, 2000) which proved that the virus had jumped from avian species to human species.

In 2009, the world must be prepared for the worst case: a double antigenic drift combined with increased virulence (Kilbourne, 1997). As of March 2009, all prerequisites for the start of a pandemic have been met except for the onset of efficient human-to-human transmission. Since no virus of the H5 subtype has probably ever circulated among humans, population vulnerability to an H5N1-like pandemic virus would be universal (World Health Organization, 2005). While there is documentation of previous responses to pandemics, there is a lack of evidence regarding effective preparedness strategies.

> In the case of pandemics, we are planning for the equivalent of a tornado in Massachusetts – rare and completely unpredictable until the last minute, when a "weather watch" appears on the TV screen. Our weather watch is "pandemic alert" when a major antigenic change is detected (Kilbourne, 1997, pg. S29).

H5N1 is of particular concern to human health for two reasons. First, H5N1 has a documented ability to pass directly from birds to humans. Avian migration increases the possibility for widespread disease across the globe. Second, once in humans, H5N1 causes severe disease with very high mortality (World Health Organization, 2005). The incubation period is unclear because of possible multiple exposures to the virus, but may be two to eight days or as much as 17 days (World Health Organization, 2006a). These two features combine to make H5N1 of great concern for a third reason: its potential to ignite an especially severe pandemic. In the Asian outbreaks of 2004, more than 120 million birds died or were destroyed within three months from January to March. That figure is higher than the combined total from all previous large outbreaks of highly pathogenic Avian Influenza recorded throughout the world over four decades (World Health Organization, 2005). This speaks to the gravity of concern

regarding H5N1. It is suspected that the next pandemic will be within 40 years of the last, occurring in 2008 counting from the 1968 pandemic or 2017 counting the 1977 flu outbreak (Kuszewski & Brydak, 2000; Potter, 2001), and Avian Influenza is the most likely suspect (World Health Organization, 2005).

Avian Influenza has likely lain dormant in migratory birds without harm for centuries. Never have so many birds become infected at once as the recent outbreaks (2003-2006) in Asia in the Republic of Korea, Vietnam, Japan, Thailand, Cambodia, Lao People's Democratic Republic, Indonesia, and China (World Health Organization, 2005). Recent human cases have occurred among people who live in rural or semi-urban communities who keep poultry in their households where they are allowed to roam free (World Health Organization, 2005). The virus has primarily affected previously healthy children and young adults, and illness has resulted from direct or close contact with H5N1-infected poultry or H5N1-contaminated surfaces (Centers for Disease Control and Prevention, 2006b). It is likely that the pandemic will begin in such communities and spread through human-to-human transmission rather than through migratory birds, although the role of migratory birds is not entirely clear (World Health Organization, 2005).

Historically, human infections with Avian Influenza have been rare and have caused only mild illness. An outbreak of highly pathogenic H7N7 Avian Influenza, which began in the Netherlands in February 2003, caused the death of one veterinarian two months later, and mild illness in 83 other humans. Mild cases of Avian Influenza H9N2, which is not highly pathogenic in birds, occurred in children in Hong Kong in 1999 (two cases) and in mid-December 2003 (one case) but was not spread through human-to- human transmission and was easily contained (World Health Organization, 2004).

H5N1 has been the exception, spreading far more virulently than other types of Avian Influenza. As of January 19, 2009, there have been 397 cases and 249 human deaths world-wide from Avian Influenza (World Health Organization, 2009). In the H5N1 cases, pneumonia was directly caused by the virus, did not respond to antibiotics, and was rapidly fatal; victims died in a matter of days. Influenza viruses are highly unstable and prone to small mutational errors, but they also have a segmented genome, consisting of eight genes, that allows easy swapping of genetic material when a host is co-infected with two different viruses (World Health Organization, 2005). Continued, extensive exposure of humans to H5N1 viruses increases the likelihood that the virus will acquire the necessary characteristics for efficient human-to-human transmission through genetic mutation or reassortment with a prevailing human influenza A virus. Humans could be directly infected with a purely Avian Influenza virus, such as H5N1, and also serve as the mixing vessel for the exchange of virus genes. Additionally, contemporary human H3N2 influenza viruses are now endemic in pigs in southern China, and can reassort with Avian H5N1 viruses in this intermediate host (Li, Guan, Wang, Smith, Xu, et al., 2004; Potter, 2001). This finding gives human infections with H5N1 added significance as a warning signal that a pandemic may be imminent.

In late 2008 there were outbreaks of Avian Influenza in India (Special Correspondent, 2008), Egypt (United Nations Office for the Coordination of Humanitarian Affairs, 2008), and Hong Kong (Schnirring, 2008). In January 2009, another outbreak of bird to human transmission of Avian Influenza occurred in China, and close contacts of the affected were quarantined (*Travelers warned to be aware of avian flu outbreak in China*, 2009). Although these outbreaks primarily affected poultry and other birds, the threat of human-to-human transmission is considered imminent by health officials (World Health Organization, 2005). The spread of the

virus through human vectors would cause serious health and economic consequences devastating populations world-wide.

Populations Most At-Risk

Although a pandemic would affect populations around the world, those at highest risk for contracting influenza first are low-income populations. Influenza is a highly infectious respiratory disease transmitted by the inhalation of microdroplets (Kuszewski & Brydak, 2000), and adults and children of lower socioeconomic status (SES) are at higher risk for a variety of communicable diseases, particularly respiratory illnesses (Cohen, 1999). The increased risk can be explained in two ways. The first is that people with decreased SES have increased exposure to infectious agents. Lower SES families live in more crowded conditions and often have more children. Both of these conditions are conducive to the spread of infectious agents. Poor environmental sanitation and poor hygienic practices may also increase exposure among poor and less educated groups (Cohen, 1999).

The second explanation is that the impacts of lower SES may alter the body's ability to fight off infections. Those with lower SES may lack information about vaccination, lack access to medical care or be unable to afford seasonal flu vaccinations which boost the immune system's ability to respond to specific infectious agents and reduce incidence and severity of illness. Given the 2009 world-wide economic crisis, more people will be unable to access medical care or vaccinations making this at-risk group larger. Malnutrition may suppress the immune system's ability to fight off infections and contribute to poor host resistance. Other health practices associated with increased risk of respiratory infection such as inadequate physical activity and poor sleep quality are also most prevalent among those with low SES (Cohen, 1999). Additionally, lower levels of SES are associated with more stressful life events, a risk factor for

upper respiratory infections (Cobb & Steptoe, 1996; Cohen, 1999). In 2007, approximately 13% of the US population (39.17 million people) lived in poverty (Bishaw & Semega, 2008) making this a large at-risk population.

Although a pandemic is likely to spread among low-income communities at a rapid rate, it is important to note that other populations may also be at increased risk for contracting influenza. During the flu of 1918, it was not only the weak and infirm that were affected; millions of young healthy people died as well. The age-specific mortality curve resembled a "W" with high mortality rates in healthy young adults aged 20-40 years as well as in those less than five years of age and those age 65 years and older (Glezen, 1996). For most pandemics, those at greatest risk are the elderly and the very young. These same people are, for the most part, at the end of the transmission chain; they do not introduce influenza into the household. Epidemics are spread quickly by healthy susceptible school children, college students, and employed persons who have many daily contacts and are highly mobile (Glezen, 1996). Although young children and young adults have been most affected, they are also the most likely to be in close proximity to household animals (World Health Organization, 2006a). It is still unclear what age groups will be most susceptible to the current Avian Influenza strain (Kuszewski & Brydak, 2000).

Health Impact

Major infectious disease outbreaks have killed more people than war (Gostin, Sapsin, Teret, Burris, Mair, et al., 2002). Pandemics are global disease occurrences associated with rapid world-wide spread, health care system overload, inadequate medical supplies, and economic and social disruption (United States Department of Health and Human Services, n.d.). Over 779 thousand Americans and 52.7 million people world-wide died from pandemics in 1918, 1957, and 1968 combined. The flu of 1918 killed 675 thousand in the U.S. alone, and influenza killed

69.8 thousand and 33.8 thousand Americans in 1957 and 1968, respectively. Although increased surveillance and use of vaccines have helped to mitigate more recent pandemics including the 1968 Hong Kong Flu and 1976 Swine Flu (United States Department of Health and Human Services, n.d.), extensive international travel and trade could cause rapid worldwide spread of novel influenza in modern times.

People infected with the current strain of Avian Influenza (H5N1) have shown symptoms ranging from typical human influenza-like symptoms (fever, cough, sore throat, and muscle aches) to pneumonia, severe respiratory diseases, and other life-threatening complications. The human mortality rate for those infected with H5N1 is 61% (United States Department of Health and Human Services, n.d.) and morbidity has occurred anywhere from a few days to a few weeks after exposure (World Health Organization, 2006a). Prevention and preparedness are the keys to implementing rapid and appropriate counter measures. In addition to health consequences of a pandemic, the economic consequences could be devastating, particularly given the state of the world-wide economy today.

Economic Impact

It is unclear exactly what the economic impact of a pandemic would be; however, researchers have modeled the potential economic effects of a future outbreak based on the affects of the flu of 1918, predicting 89 to 207 thousand deaths; 314 to 734 thousand hospitalizations; 18 to 42 million outpatient visits; and 20 to 47 million additional illnesses in the U.S. (Meltzer, Cox & Fukuda, 1999). The Congressional Budget Office (Congressional Budget Office, 2005) estimates that 30% of all workers would become ill and 2.5% would die. With 30% of workers missing an average of three weeks of work, the result would be a decrease in the US gross domestic product of 5%. Between 18 and 45 million people would require outpatient care and economic costs

would total approximately $711 billion (2007 dollars) (Congressional Budget Office, 2005). Even with a gross attack rate in the U.S. of 15%, there would be an estimated mean of $88.13 billion (2007 dollars) in economic losses in the United States (Meltzer, et al., 1999). Emergency preparedness measures must be in place in order to mitigate both the health and economic consequences of a pandemic.

Emergency Preparedness and Response

In the event of a public health emergency, Americans expect public health agencies to take action to limit morbidity and mortality (Salinsky, 2002). State and local health departments will have to take on the responsibilities of preparedness and response (Salinsky, 2002) in a pandemic outbreak. Emergency preparedness refers to the readiness of a political jurisdiction to react constructively to threats from the environment in a way that minimizes the negative health and safety consequences of individuals and the integrity and functioning of physical structures and systems. The achievement of emergency preparedness takes place through a process of planning, training, and exercising (Perry & Lindell, 2003).

Emergency planning is driven by two objectives: hazard assessment and risk reduction. Hazard assessment involves not only identifying threats that have previously affected the community, but also employing technology that leads to prompt identification of new or potential threats. In the case of pandemic influenza, the risk has been initially identified; however, hazard assessment is an ongoing process through surveillance and epidemiology as the level of risk continues to be unclear. Risk assessment includes identifying and monitoring risks through inter-governmental partnerships among local jurisdictions and higher governmental authorities with greater available resources (Perry & Lindell, 2003).

Risk reduction involves an examination of the actions necessary to decrease the detected or projected levels of danger and to identify the resources required for implementing those actions. Since the available resources are rarely equal to the threat, this process defines the remaining level of danger considered to be acceptable. The decision to manage a particular hazard and the level of protection to be sought draws upon technology and available interventions, but has a political element. Funding and resource levels are allocated by government agencies and require buy-in from political actors who decide how resources may be used. Risk reduction may be viewed as the development and implementation of activities aimed at mitigation, preparedness, response, and recovery (Perry & Lindell, 2003).

There are four components of all emergency management programs, regardless of the hazard. *Mitigation* includes activities that reduce the degree of long term risk to human life and property from hazards. *Preparedness* includes activities that develop operational capabilities for responding to an emergency. *Response* includes activities taken immediately before, during, or directly after an emergency that save lives, minimize property damage, or improve recovery. *Recovery* includes short-term activities that restore vital life-support systems to minimum operating standards and long-term activities that return life to normal (McLoughlin, 1985). While these components are key factors in emergency management, the study I conducted focused specifically on planning and mitigation for pandemic influenza because without the initial planning phase, drills and responses are more likely to fall short. Pandemics are unique because they occur in waves with extended periods of impact, unlike other disasters such as bombings or floods which have a short-term impact and long recovery period. Effective responses depend upon international, national, state, and local reactions and integration between each of these levels of response.

Global Response

The World Health Organization (WHO) has a sophisticated international surveillance system with hundreds of labs world-wide regularly reporting influenza information (Potter, 2001). The WHO has mapped out a response plan with three objectives: to avert a pandemic, to control the outbreak in humans and prevent further cases, and to conduct the research needed to monitor the situation and improve preparedness including the immediate development of a pandemic vaccine. If human-to-human transmission of H5N1 or any other novel pandemic strain is discovered, the WHO will work with the affected country to contain and treat the spread of disease (World Health Organization, 2006b).

When signs of human-to-human transmission are discovered, the WHO will implement a plan to control the outbreak as much as possible at its source by sending representatives to investigate any potential novel disease outbreaks. Control measures will be implemented by physicians and public health personnel as well as first responders and will include isolation of clinical cases, identification and voluntary home quarantine of asymptomatic close contacts, administration of antiviral drugs, infection control in health care facilities, promotion of hand and cough hygiene, and domestic cleaning to reduce transmission (World Health Organization, 2006b).

Domestic Response

The National Response Framework defines how the federal government will respond to domestic situations in which the President has declared an emergency. This framework identifies the Department of Health and Human Services (DHHS) as the primary federal agency responsible for the medical and public health response to emergencies (Salinsky, 2002). While

DHHS will take the lead in a federally declared emergency, it will depend upon state and local agencies for “on the ground” responses prior to and after such a declaration.

The federal government has published recommendations (Centers for Disease Control and Prevention, 2006c), created a web site (United States Department of Health and Human Services, n.d.), and conducted evaluations (Centers for Disease Control and Prevention, 2008) to help state and local governments prepare for a pandemic. Additionally, millions of dollars have been granted to states since the late 1990’s for public health infrastructure and preparedness (Salinsky, 2002). In order to assist states and localities in planning for a pandemic, the 50 states, the District of Columbia, three local jurisdictions (New York City, Chicago and Los Angeles County), five U.S. Territories, and three Freely Associated States of the Pacific shared $325 million in cooperative agreement emergency supplemental funds to help create and fill gaps in their pandemic influenza preparedness plans and to test these plans. Phase one of funding, $100M, was announced January 12, 2006. Phase two, $225M, was announced July 11, 2006. In August 2007, a supplemental $75M was announced as well (United States Department of Health and Human Services, n.d.).

The federal government has offered funding, guidance, and written materials to assist in state and local pandemic planning (Centers for Disease Control and Prevention, 2006a, 2006c; United States Department of Health and Human Services, 2004, n.d.) however, because states have different needs and populations, federal agencies have offered limited supervision during the plan writing process. The states’ role will be to coordinate both the local and federal response, and state health departments must have specific policies and procedures in place prior to the onset of illness. States have the primary responsibility for protecting the health and welfare of their citizens and are ultimately responsible for responding to a public health emergency

(Salinsky, 2002). In the event of large scale illness, written plans should allow non-traditional responders the ability to react appropriately with minimal experience or training. Although the implementation of state plans will vary by location, there are certain criteria that should be universally addressed in the creation of such plans.

Most states have a single agency that takes "lead" responsibility for emergency preparedness and response activities. The nature of such agencies and their lines of authority vary, but they all fall into one of five types of organizations. Authority in all cases is legislated to the governor, but is operated in: 1) the executive office, or delegated 2) to a civilian department, 3) to the adjutant general, 4) to the state police, or 5) to a council which oversees departmental activities depending on the type of emergency (McLoughlin, 1985). For example, in a criminal attack, police would take the lead on responding and investigating the event, while the response to a disease outbreak would be delegated to the health department. Communicable disease threats do not affect communities in the same manner as other disasters such as floods, bombings, tornadoes, and the like. The lead agency differs in disease outbreak events. Communicable disease threats are managed by state health departments in coordination with the Centers for Disease Control and Prevention (CDC) with the assistance of typical emergency responders, such as emergency management agencies, police, and the health care system (United States Department of Health and Human Services, n.d.).

The state has emergency responsibilities that local governments do not share. While local responders are first at the scene of an emergency, they have limited resources to respond to a large-scale event. The state is in a unique position to gage the emergency management needs of its political subdivisions because of its oversight of and relationship with local emergency management agencies (McLoughlin, 1985). Additionally, the state can assess its own resources

and those of the federal government, and facilitate the acquisition and application of these resources. State governments also give direct guidance and assistance to local jurisdictions in program development and channel federal guidance and assistance to communities. In a major emergency, the state ensures a coordinated response through the combined efforts of local, state, and federal agencies and private sector organizations (McLoughlin, 1985).

Local governments such as municipalities and counties maintain initial responsibility for responding to a disaster. Local public health agencies are on the front lines of responding to a disaster and must work with other first responder agencies including police, fire, emergency medical services, hazardous materials teams, physicians and hospitals in order to prepare for disasters (Salinsky, 2002). When an emergency occurs, these jurisdictions have to assess the damage accurately and submit requests for assistance to state emergency services offices and the governor (Waugh, 1994). The nature of the emergency planning process for localities will correspond to the size of the community in which such planning takes place (Perry & Lindell, 2003). Larger communities with more elaborate government structures, increased resources and personnel, and higher staff turnover, tend to depend on formalized processes and rely more heavily upon written documentation and agreements (Perry & Lindell, 2003). In smaller communities, the planning process may rely more heavily upon informal, personal relationships for risk identification, assessment, and reduction (Perry & Lindell, 2003).

The limited resources of most local governments make emergency management difficult because disasters often cross jurisdictional boundaries and demand more resources than local governments typically possess. Local officials are almost always the first responders to emergencies and have legal jurisdiction until they ask for outside assistance (Waugh, 1994). Local emergency management efforts are difficult because of the diversity of hazards and

disasters, low salience of emergency management, resistance to planning and regulation, lack of political constituents, uncertain risk for hazards, technical complexity of response efforts, jurisdictional confusion, economic and policy challenges that impede government expansion, and limited capacity to implement and maintain emergency management systems (Waugh, 1994).

Response Elements

While there is no "model plan" that will serve every community effectively, there are some key elements to general preparedness planning. Perry and Lindell (2003) outline 10 key guidelines for preparedness planning: 1) emergency plans must be based upon accurate knowledge of the threat and of likely human response; 2) plans should encourage appropriate actions by emergency managers; 3) plans should acknowledge that all disasters create dynamic changing environments and jurisdictions cannot plan for all contingencies; 4) plans must address inter-organizational coordination; 5) plans should integrate strategies for individual hazards into a comprehensive approach for multi-hazard management; 6) plans should have a training component; 7) plans should provide for testing proposed response operations; 8) planning is a continuous process; 9) planning is almost always conducted in the face of conflict and resistance; 10) emergency plans should recognize that planning and management are different functions and that the test of plans rests with their implementation during an emergency. All of these issues must be kept in mind during planning for any hazard.

Pandemic Preparedness Recommendations

In pandemic planning, government agencies have looked to the CDC for guidance in planning for this specific hazard. The ten principles noted above have been incorporated into CDC recommendations along with specific areas that should be included in all state and local pandemic influenza plans. A pandemic will not recognize state borders, and there must be consistency across plans to ensure an effective and coordinated response. Until an outbreak occurs, there is no way to truly evaluate pandemic response plans; however, it is possible to evaluate the steps that have been taken to be prepared. Each of the domains recommended by the CDC (2006c) in its State and Local Pandemic Influenza Planning Checklist is noted and explained below (See Table 1):

Table 1. Centers for Disease Control and Prevention State and Local Pandemic Influenza Planning Checklist Domains (Centers for Disease Control and Prevention, 2006c)

Domain	**Description**
Community Preparedness Leadership and Networking	Working with other organizations and jurisdictions to ensure responsibilities are clearly delineated.
Surveillance	Domestic and international surveillance systems that identify prevalent strains and characterize their effect on human health are imperative for detecting and treating influenza.
Public Health and Clinical Labs	State lab capacity for detecting novel strains of influenza can reduce the time between detection and treatment of influenza.
Health Care and Public Health Partners	Preparedness will require building new partnerships with the medical community, law enforcement and public safety, emergency services, disaster-management personnel, and government officials (Khan, Morse & Lillibridge, 2000).
Infection Control and Clinical Guidelines	Health care providers are essential in the detection of an initial case of novel or pandemic influenza in a community.
Vaccine Distribution and Use	Vaccines are probably the most effective measure to reduce morbidity and mortality during a pandemic (Oshitani, 2006).
Antiviral Distribution and Use	Antivirals are expected to be effective against pandemic influenza and will be the only available pharmaceutical intervention until vaccine production (Oshitani, 2006).
Community Disease Control and Prevention	Prior to antiviral and vaccine availability, preventive public health interventions will have to be utilized to reduce the spread of disease.
Public Health Communications	Risk communication during an emergency is a critical element in responding quickly and appropriately to a public health threat.
Workforce Support: Psychosocial Considerations and Information Needs	In the case of pandemic influenza, particularly before a vaccine becomes available, all health responders are likely to experience high levels of stress.

Community Preparedness Leadership and Networking

Traditionally, responders, organizations, and authorities may work together for the first time during an emergency. Collaboration between these disparate groups can often lead to difficulties with communications, ambiguity of authority, and poor utilization of special resources. Such difficulties can be overcome when there is consensus and cooperation among organizations

before an event happens. Consensus occurs when each organization understands its purpose, its role, and the role of other organizations (Lindell & Perry, 1992; Tierney, Lindell & Perry, 2001). An important part of the planning process includes working with other organizations and jurisdictions to ensure responsibilities are delineated clearly in the event of a disaster. The time to do this is before an event happens, not during one.

The CDC (2006c) recommends that each state maintain a pandemic preparedness committee with key stakeholders; however, they leave it to the states to decide who composes the committee. Timelines, deliverables, and performance measures should be included in all planning processes as well as compliance with the National Incident Management System (NIMS) and maintenance of an Incident Command System (ICS).

NIMS and ICS are federally created and mandated incident response structures that are utilized during a multiple-agency response to ensure integration among response agencies and personnel. The NIMS uses a systems approach to integrate the best of existing processes and methods into a unified national framework for incident management. All first responder agencies are required to utilize and train staff and volunteers in the NIMS system. NIMS benefits include a unified approach to incident management; standard command and management structures; and emphasis on preparedness, mutual aid and resource management. Similar to NIMS, ICS is a hierarchical organizational structure used to organize emergency responders in an emergency. ICS is scalable to each emergency and can be used to integrate multiple responder agencies into a unified response system (Federal Emergency Management Agency, 2007).

The CDC (2006c) also recommends, among other things, that jurisdictions formalize agreements with their neighbors, maintain a demographic profile of the community, implement a

process for resource requests, identify agencies with the authority to implement an emergency plan, and ensure the plan is scalable.

Surveillance

While community preparedness, leadership, and networking are necessary for all emergency preparedness and response scenarios, domestic and international surveillance systems that identify prevalent strains and characterize their effect on human health are key to detecting and treating influenza (United States General Accounting Office, 2003). The incidents of Avian Flu that took place in 1997 stressed the role of surveillance in detecting disease outbreaks (Kuszewski & Brydak, 2000), and surveillance must be a key component for any public health preparedness plan (Centers for Disease Control and Prevention, 2006c).

Holmberg, et al. (2006) found that most states rely on National Sentinel Physician Surveillance (NSPS) and/or the 122 Cities Mortality Reporting System of pneumonia- and influenza-related deaths for flu surveillance. Approximately 260 physicians around the country report the total number of patients seen and the number of those patients with influenza-like illness by age group to NSPS each week (Centers for Disease Control and Prevention, 2005).

As part of its national influenza surveillance effort, the CDC receives weekly mortality reports from 122 cities and metropolitan areas in the United States within 2-3 weeks from the date of death. Mortality reports, compiled by the Epidemiology Program Office (EPO) of CDC, summarize both the total number of deaths occurring in these cities/areas each week, as well as the number due to pneumonia and influenza (Centers for Disease Control and Prevention, 2005)

According to DHHS (United States Department of Health and Human Services, 2004) state surveillance responsibilities include: Continuing to employ coordinators to oversee improvements in influenza surveillance (e.g., virologic, outpatient, hospitalization, and mortality

surveillance); conducting influenza surveillance year round; implementing enhanced surveillance for detection of the first U.S. cases of novel virus infection; isolating and subtyping influenza viruses year round; and improving capacity for rapid identification of unusual influenza strains. Additionally, states must submit weekly reports to DHHS to ensure continued monitoring of influenza. The CDC recommendations also suggest states focus on increasing capacity for rapid identification of novel strains, sharing data from surveillance systems, and tracking information daily during a pandemic (Centers for Disease Control and Prevention, 2006c).

Public Health and Clinical Laboratories

State lab capacity for detecting novel strains of influenza can reduce the time between detection and treatment of influenza. A 1995 survey found that 10 states (20%) had no state public health laboratory capacity to isolate viruses and 13 states (25%) reported no ability to subtype influenza isolates (Gensheimer, Fukuda, Brammer, Cox, Patriarca, et al., 1999). More recently, the CDC noted that there has been an increase in the number of Bio-Safety Level 3 Labs from 69 labs in 2001 to 139 labs in 2005 and 150 biological Laboratory Response Network (LRN) reference labs up from 91 labs in 2001 (Centers for Disease Control and Prevention, 2006a). However, it is unclear which states had increases based on the CDC report. Gaps in lab capacity must be addressed in order to ensure state lab ability to detect novel strains of influenza.

Current CDC recommendations list the following for lab preparedness: planning for laboratory surge capacity to meet diagnostic testing needs during a pandemic, assessing lab staff testing proficiency for isolating novel influenza strains, and informing clinicians and personnel about proper protocols for safe specimen collection and testing (Centers for Disease Control and Prevention, 2006c). The CDC does not offer recommendations for how to implement these recommendations, but only recommends that they be addressed.

Healthcare and Public Health Partners

Preparedness will require building new partnerships with the medical community, law enforcement and public safety, emergency services, disaster-management personnel, and government officials (Khan, et al., 2000; Morse, 1995). Public health preparedness depends in large part on private clinicians who are trained to recognize emergency situations and report suspicions to public health officials (Salinsky, 2002). The CDC specifically focuses on partnerships between public health and clinical medicine for pandemic flu preparedness. Recommendations include focusing on surge capacity and mortuary provisions, maintaining rosters of emergency healthcare personnel, and having open communication between public health and healthcare providers to ensure information is shared between both sectors (Centers for Disease Control and Prevention, 2006c).

Infection Control and Clinical Guidelines

Healthcare providers are essential in the detection of initial cases of novel or pandemic influenza in a community. Early identification and isolation of cases may help slow the spread of influenza within a community. After identification of a novel influenza strain is made, federal health authorities at the CDC are responsible for alerting the media, health departments, and clinicians. Clinical awareness of novel or pandemic influenza disease can also benefit individual patients as rapid diagnosis and initiation of treatment can avert potentially severe complications. However, detection is complicated by the lack of specific clinical findings and commercially available laboratory tests that can rapidly distinguish novel or pandemic influenza from seasonal influenza. In addition, neither the clinical characteristics of a novel or pandemic influenza virus strain nor the groups at highest risk for complications can necessarily be defined beforehand. Therefore, both individual clinicians and health care institutions face significant challenges in: 1) quickly

identifying and triaging cases, 2) containing the spread of infection, 3) beginning an efficient and comprehensive workup, 4) initiating antiviral and other supportive therapy, and 5) anticipating clinical complications (United States Department of Health and Human Services, 2005).

Healthcare providers play an important role in the detection and treatment of pandemic influenza, and their functions must be included in any written pandemic influenza plan. The CDC (Centers for Disease Control and Prevention, 2006c) recommends that 80% of frontline healthcare personnel be reached by the Health Alert Network which regularly notifies key stakeholders about emerging health threats. Additionally, written plans should include provisions for messages being disseminated to educate healthcare providers, and having local access to EPI-X, a CDC web-based communication system where epidemiologists can freely exchange information about health issues and trends in their communities. States and localities must have sufficient resources to ensure their clinicians have access to up to date information about potential viral threats.

Vaccine Distribution and Use

Vaccines are probably the most effective measure to reduce morbidity and mortality during a pandemic (Oshitani, 2006). However, the impact of vaccines, though potentially great, remains to be demonstrated. In 1957 and 1968, vaccine manufacturers responded rapidly, but limited production capacity resulted in the arrival of inadequate quantities too late to have an impact (World Health Organization, 2005). The vast majority of proposed expenditures in the $6.7 billion federal influenza plan are devoted to medical countermeasures with $4.7 billion allotted for cell-based vaccine technology and stockpiling of experimental vaccine, and $1.4 billion for antiviral medication. However, vaccines are not likely to be available at the early stages of a

pandemic (Oshitani, 2006). Stockpiling experimental vaccines may tie up resources that could be used to reduce transmission rates by implementing other public health interventions.

Currently, the precise antigenic properties of a pandemic strain cannot be predicted, so available vaccines may be poorly antigenically matched to the pandemic virus. Manufacturing capacity, the ability of candidate vaccine strains to grow well in eggs, and biological safety containment of parent strains for vaccine development are all problems to be addressed. Additionally, a major concern with using a live, weakened form of the virus in an influenza vaccine is the risk for reassortment of the vaccine virus with a circulating influenza virus. This reassortment could result in a novel subtype of influenza that could spread in the human population. The risk for reassortment must be carefully considered before a decision is made to introduce a live, attenuated vaccine in a threatened pandemic (Luke & Subbarao, 2006).

In 2005, a $62.5 million Federal contract was awarded to Chiron Corporation to manufacture an Avian Influenza vaccine designed to protect against the H5N1 influenza virus strain. The contract built on the DHHS' plans to buy enough H5N1 influenza vaccine for 20 million people and enough influenza antivirals for an additional 20 million people. Supplies of vaccine and antiviral treatment will be placed in the nation's Strategic National Stockpile where they will be available for use should an influenza pandemic occur. The number of individuals who could be protected by the newly contracted vaccine is still to be determined by ongoing clinical studies (United States Department of Health and Human Services Press Office, 2005). It is unclear who will pay for mass vaccinations if and when they become available for the remaining 200 million people. The cost of creating the vaccine may be millions of dollars and it is unknown if private insurance, Medicaid, or Medicare will pay for it. There are also millions of uninsured who may not have access to the vaccine if distribution is not publicly funded.

The CDC offers a number of recommendations for addressing the use of vaccines in state pandemic preparedness plans including: having a plan for distribution, use, and monitoring the effectiveness of vaccines; tracking the number of vaccine recipients; identifying vaccine priority populations; creating a distribution plan and including security and logistics of distribution and maintaining the vaccine itself. Addressing the needs of vulnerable and hard-to-reach populations are also important recommendations.

Antiviral Distribution and Use

Antivirals are expected to be effective against pandemic influenza and will be the only available pharmaceutical intervention until enough vaccines are produced (Oshitani, 2006). There are a variety of antivirals that have been considered for use at the onset of a pandemic. Amantadine and rimantadine share properties as antiviral agents useful in a pandemic situation (Hayden, 1997). However, the current production capacity within a six to 12 month period for these drugs in the United States is approximately 250 million doses. This is estimated to be a sufficient short-term treatment for 5%-10% of the general population or seasonal prophylaxis (60 days) for 5% of the high risk population. Both antivirals may have severe side effects and there have been relatively few studies that have assessed the prophylactic activity of these drugs in a pandemic situation. Amantadine and rimantadine have been shown to be therapeutically effective if initiated within 1-2 days of symptom onset in young, previously healthy adults; however, it has not been established whether treatment is effective in severe influenza or preventing influenza in high-risk populations. Another issue regarding these drugs is viral drug resistance. Patients who are treated with amantadine and rimantadine may shed resistant virus strains that pose problems for others (Hayden, 1997).

Ribavirin, a synthetic nucleoside, has a broad antiviral spectrum, but its possible value in managing severe influenza needs to be addressed in a controlled trial. Neuraminidase (NA) Inhibitors have also been considered as a prophylaxis for pandemic flu. Intranasally administered zanamivir is associated with potent antiviral effects and protection against experimentally induced influenza A infection and illness in humans. Additional studies must be completed to assess appropriate dosage levels and production capacity. It is also uncertain whether particular combinations of antiviral drugs can reduce the emergence of a drug-resistant virus (Hayden, 1997).

Shortage of supply and high cost of antiviral medication are still major limiting factors in amassing large stockpiles (Oshitani, 2006). The federal government is currently stockpiling antivirals for each state based on population. Its goal is to stockpile enough antivirals for 25% of the population. In addition, it is making 31 million courses available for state purchase with a federal subsidy of 25% (United States Department of Health and Human Services, n.d.). States that are wealthier will be able to purchase more antiviral medications than their poorer counterparts. Also, it is unknown how many courses of anti-viral medications will be needed to prevent or mitigate the symptoms of pandemic flu. If each individual needs multiple courses, antivirals may quickly run out. Another important consideration is the possible emergence of resistant strains which would leave antivirals useless (Oshitani, 2006).

The CDC offered recommendations to states for antiviral planning. State pandemic influenza plans should include a plan for distribution and use of antiviral drugs via the Strategic National Stockpile and should test the operational plan for antiviral procurement. States should also have a contingency plan for unlicensed antiviral drugs (Centers for Disease Control and Prevention, 2006c). Although not included in the CDC recommendations, because of the limited supply of

antivirals, priority populations such as first responders, medical personnel, and public health officials should be decided upon, as should the payment mechanism for antivirals.

Community Disease Control and Prevention

In 1999, the federal government enacted the Public Health Service Act which authorizes the "apprehension, detention, or conditional release" of individuals for a small number of diseases listed by executive order including cholera, diphtheria, infectious tuberculosis, yellow fever, viral hemorrhagic fevers, SARS, and novel influenza virus with pandemic potential ("Executive Order 13295", 2003). These regulations would empower the CDC to provisionally quarantine ill passengers from the US or abroad for up to three business days, and to order full quarantine on the grounds of a reasonable belief that a person or group is in the qualifying stage of a quarantinable disease (Gostin, 2006). Federal containment powers are reserved for interventions at US borders and to mitigate interstate spread of infection (Gostin, 2006).

It is clear that vaccines and antivirals will likely not be available at the onset of pandemic flu. In the meantime, preventive public health interventions will have to be utilized to reduce the spread of disease. Community containment strategies, including isolation, quarantine, snow days, and increased personal and medical institution hygiene are fundamental public health measures used to control the spread of communicable diseases (Centers for Disease Control and Prevention, 2004). These strategies all have the primary goal of preventing person-to-person spread of illness by separating those with disease or at increased risk for developing disease from those at lower risk.

Isolation refers to the separation of ill persons with a communicable disease from those who are healthy. Isolation not only prevents transmission of infection to others, but also allows for the focused delivery of specialized health care to ill persons. Quarantine is the separation or

restriction of activities of persons who are not ill, but who are believed to have been exposed to a communicable disease and are at highest risk of becoming infected. Community containment measures may be applied to groups of persons or to communities during outbreaks characterized by extensive transmission. These interventions range from measures to increase social distance among community members to community-wide quarantine (Centers for Disease Control and Prevention, 2004).

Quarantine and isolation can often be complementary in disease mitigation. Quarantine measures were applied in several countries during the flu of 1957 postponing the onset of an epidemic by weeks or months (World Health Organization, 2005). When isolation is ineffective, the use of quarantine will be beneficial when there is significant asymptomatic transmission and if the asymptomatic period is neither very long nor very short (Day, Park, Madras, Gumel & Wu, 2006). Quarantine would separate those who have been exposed to the disease but have not become symptomatic in order to ensure they do not become ill or spread the disease further. The success of isolating symptomatic individuals and tracing and quarantining their contacts is determined as much by the proportion of transmission occurring prior to the onset of clinical symptoms as the inherent transmissibility of the etiological agent. Direct estimation of the proportion of asymptomatic and presymptomatic infections is achievable by contact tracing which should be a priority during an outbreak of a novel infectious agent (Fraser, Riley, Anderson & Ferguson, 2004).

Efforts that reduce disease reproduction numbers in the source region and severe travel restrictions are most effective for delaying a local epidemic and could add several months to the delay. Border screening for symptomatic infection, wearing protective masks during travel, promoting early presentation of cases arising among arriving passengers and moderate reduction

in travel volumes could increase the delay by days or weeks (Becker, 2004; Caley, Becker & Philp, 2007).

Social distancing can also be effective in reducing the spread of influenza. According to the WHO (2005), the temporary banning of public gatherings and closure of schools are potentially effective measures that would not have to be imposed for long periods of time. Such measures could buy enough time to begin manufacturing of a vaccine as well as flatten the epidemiological peak, distributing cases over a longer period of time.

For influenza as infectious as the 1957-1958 Asian flu, closing schools and keeping children and teenagers at home can reduce the attack rate by >90%. For more infectious strains, or transmission that is less focused on the young, adults and the work environment must also be targeted (Glass, Glass, Beyeler & Min, 2006). Public health interventions strengthen local defenses against a highly virulent strain in the absence of vaccines and antiviral drugs.

Although selected public health interventions including infection control and isolation of patients could slow the initial spread of a pandemic, allowing more time for response measures to be implemented, the discussion about public health preparedness measures has been limited. An international conference convened by the NIH's Division of Microbiology and Infectious Diseases, National Institute of Allergy and Infectious Diseases (NIAID) on pandemic influenza was devoted only to antivirals and vaccines. The overall goal of the meeting was to increase pandemic preparedness by focusing attention on the research approaches to controlling pandemic influenza; however, there was no discussion about public health prevention measures (Moto, Iacuzio & La Montagne, 1997).

However, the CDC does include community disease control and prevention measures in its state preparedness plan recommendations. States should have a plan to investigate and contain

potential cases; and a plan for isolation and quarantine noting who has the authority to implement such measures. Also included in state plans should be methods for supporting the contained, an operational plan for restricting movement, and a plan to inform citizens of what is happening and why.

Public Health Communications

Communication during an emergency is one of the most important elements in responding quickly and appropriately to a threat (United States Department of Health and Human Services, 2004). Communication includes coordinating with public and private partners, training spokespersons, and implementing community resources (Centers for Disease Control and Prevention, 2006c). Risk communication is defined as the interactive process of exchange of information and opinion among individuals, groups, and institutions; and it often involves multiple messages about the nature of risk or expressing concerns, opinion, or reactions to risk messages (United States Department of Health and Human Services, 2002). During a pandemic, the media and the public will look to scientists, politicians, and health officials for information about their risk of contracting illness and what to do to keep their families healthy.

Public officials can take steps in advance of an incident to better prepare communities, risk managers, government spokespersons, public health officials, the news media, physicians, and hospital personnel to respond to the challenges of managing such crises (United States Department of Health and Human Services, 2002). The CDC (2006c) recommends that states plan and coordinate emergency communication activities with public and private partners, train spokespersons, train staff about risk communication, maintain lists of key stakeholders, implement community media resources, and include provisions for a redundant communication system.

Workforce Support: Psychosocial Considerations and Information Needs

First responders have specific mental health needs because of their immersion in disaster work (Bradford & John, 1991; Deane, Steadman, Borum, Veysey & Morrissey, 1999). Ambulance personnel experience general psychopathology, burnout and posttraumatic symptoms (Alexander & Klein, 2001). Rescue, fire and medical personnel and police officers who treat victims of emergencies have high levels of stress as well (Durham, McCammon & Allison, 1986; Marmar, Weiss, Metzler, Ronfeldt & Foreman, 1996; Myers, 1995). In the case of pandemic influenza, particularly before a vaccine becomes available, all health responders are likely to experience similar mental health issues as first responders. The CDC (2006c) recommends that states ensure the availability of psychosocial support services, develop a workforce resilience program, and develop public mental health messages.

The CDC recommendations are useful for guiding state planning, but measuring if states include these recommendations in their plans has been inconsistent at best. This study will both measure state plan inclusion of these recommendations, and evaluate the factors that may predict inclusion of such measures.

Measuring Preparedness

Preparedness is defined as the capacity of the public health system to reduce morbidity and mortality arising from intentional terrorist attacks, large-scale transmission of naturally occurring agents, or natural disasters. Measuring preparedness presents a variety of challenges. Traditionally, public health preparedness has been considered in a "structure-process-outcome" framework (Nelson, et al., 2007). Structures include personnel, equipment, training, leadership/organization, planning, and exercises/corrective actions. Processes are the activities executed during a public health emergency response, including mass prophylaxis, isolation and

quarantining, public communication, and others. The outcome of the response is the maintenance and restoration of affected populations' health status.

The challenge in measuring pandemic preparedness is threefold. First, pandemics rarely occur. An ideal way to evaluate preparedness would be to compare planning activities to actual response activities (Perry & Lindell, 2003), but given the rarity of such events, this tends not to be an option (Stoto, Savoia, Biddinger & Koh, 2008). Second, the range of activities necessary to ensure an appropriate response is extensive and difficult to measure. Written plans are the initial step to pandemic planning, but activities and drills are necessary to ensure an effective response to any emergency. Clear objectives for each of these steps are difficult to define objectively and clearly (Perry & Lindell, 2003; Stoto, et al., 2008). Third, public health systems are complex and depend on multi-jurisdictional and multidisciplinary approaches (Stoto, et al., 2008; Waugh, 1994). In most "traditional" emergency events public health acts as a support agency to other responders; however, in a pandemic, public health will act as first responders and will need the support of local, state, and federal jurisdictions and response agencies. Because of this, measuring the complex interplay between these agencies is difficult and cannot be extrapolated from other response evaluations.

Preparedness for any emergency involves a coordinated and continuous process of planning and implementation that relies on measuring performance and taking corrective action (Lurie, 2007; Perry & Lindell, 2003). While pandemics have unique features that make them different from other disasters, in terms of consequences and planning milestones, there are similarities across emergencies (Perry & Lindell, 2003), thus the planning process for all-hazards has been similar (Lindell & Perry, 1992). There have been four approaches to measuring preparedness based on this definition. The first two approaches focus on infrastructure and capacities while the

second two focus on capabilities. Capacities refer to the resources that a public health system has to draw upon, while capabilities describe the operational activities the public health system can undertake to effectively identify, characterize, and respond to emergencies (Stoto, et al., 2008).

The first approach, the *unstructured assessment* is the simplest approach and occurs when a knowledgeable party judges how prepared the system is for a public health emergency or the impact of preparedness activities undertaken (Stoto, et al., 2008). Reviews conducted by government agencies (Centers for Disease Control and Prevention, 2008; National Governors Association, 2008), nonprofit agencies (Trust for America's Health, 2006), and academic researchers (Katz, Staiti & McKenzie, 2006; Savoia, Rodday & Stoto, 2009; Wright, 2008) have focused on general preparedness as well preparedness for specific hazards. While these types of assessments can be informative, there are a number of drawbacks to them. Such assessments often lack a logical framework or are not clear in addressing the event for which we are preparing. Additionally, the results are often biased if based on self-reported information. This type of assessment also may include subjective measures that are based on the perceptions and experience of the emergency planner completing the assessment, making it difficult to measure progress over time (Stoto, et al., 2008). This is a reflection of a lack of standardized, clearly defined measures for assessing preparedness.

The second approach, *inventories and capacity instruments*, involves standards-based assessments that ask whether agencies have undertaken preparedness activities or met specific functions (Stoto, et al., 2008). Instruments and measures have been proposed for specific areas including disease surveillance (National Association of City and County Health Officials, 2004) and epidemiology (Council of State and Territorial Epidemiologists, 2006), while other instruments focus on preparedness more generally (Holmberg, Layton, Ghneim & Wagener,

2006; National Association of City and County Health Officials, 2008) or include capacity reports which are often presented in terms of a report card (Levi, Vinter, St. Laurent & Segal, 2008b). Inventories suffer from some weaknesses. The biggest weakness is that they presume an evidence base linking capacity with the intended capabilities. Previous measures show little consistency in what defines "preparedness," how it should be measured, and rely on subjective capacity measures as self-reported by response agencies. Good measures must be clearly operationalized with required data elements explained (Stoto, et al., 2008).

Proxy events provide an opportunity to directly observe the public health system's response to events such as anthrax, SARS, Hurricane Katrina, food-borne illness outbreaks, or seasonal flu epidemics. Learning from proxy events can occur via a variety of methods. "Look-backs" are a simple approach of limited cost that consist of retrospectively analyzing responses to public health events (Aledort, Lurie, Ricci, Dausey & Stern, 2006; Stoto, et al., 2008). Another approach includes preparedness assessment activities during routine activities and processes (Nelson, Lurie & Wasserman, 2007). The benefit of studying proxy events includes evaluating the actual public health system in practice and its emergency response capabilities. Weaknesses include the rarity of large-scale events that stress the system as well as the inability to assess alternative outcomes had the response been different (Perry & Lindell, 2003; Waugh, 1994).

Drills and exercises can act as proxies for actual emergencies and raise awareness, enable planning and training, and provide an opportunity to identify how the public health system would respond to an actual event (Stoto, et al., 2008). Well-designed exercises can assess public health system performance, reveal gaps, uncover weaknesses, and clarify roles and responsibilities (Biddinger, Cadigan, Auerbach & al., 2008). While exercises offer promising means for

evaluating preparedness, it is not clear how best to use them to objectively and reliably measure public health system preparedness (Stoto, et al., 2008).

An ideal measurement would include all four elements; however, because widespread public health emergencies are rare, few opportunities exist to test what is considered a good response against real life experience (Nelson, et al., 2007). Instead, previous evaluations have addressed one or two elements of the measurements at a time.

Previous Studies

There have been a variety of studies that aim to measure state pandemic preparedness. Holmberg et al. (2006) reviewed 49 written state pandemic influenza response plans. Authors read and reviewed state plans to assess if states addressed and to what extent vaccination, surveillance and detection, and community containment activities. Holmberg et al. (2006) found that while states tend to focus on vaccination strategies and surveillance and detection, there is wide heterogeneity in state plan containment measures. States generally follow Advisory Committee on Immunization Practices vaccination priorities, and depend upon National Sentinel Physician Surveillance and other passive surveillance systems to alert them of potential epidemics. Additionally, few states explain nonpharmaceutical community interventions for influenza mitigation.

While Holmberg (2006) and his colleagues analyzed three focus areas of state pandemic influenza plans, they did not define measures to evaluate state written pandemic plan preparedness. The researchers did not explain their methodology except for noting that 49 publicly posted plans were reviewed. It is unclear from where the measures came and why those specific measures were chosen. It appears that the study was purely exploratory in nature, making replication difficult. Clearly defining measures to assess written plan preparedness can

offer states a concrete, quantitative way to evaluate their preparedness both internally, compared to other states, and over time.

Holmberg, et al.'s, (2006) study of state pandemic flu plans offered insight into flu planning, but only reported on state trends in containment measures rather than a comprehensive look at all of the factors that go into plan preparedness. Since written plans are the first step toward state preparedness, analyzing written plans can help offer an initial portrait of which states have addressed the minimum recommendations for pandemic preparedness. Information about gaps in planning can help guide policymakers in their funding decisions. States that are least prepared may need additional support to attain similar preparedness levels to their counterparts, or they may place additional burden on other states during a pandemic.

Trust for America's Health releases an annual study (Levi, et al., 2008b) grading each state's level of preparedness for disease, disasters, and bioterrorism. This study utilizes a ten point scale and includes a variety of measures focused on preparedness for multiple hazards. The measures change every year making this an annual cross-sectional study based on the specific areas of interest determined for that year's report. Scores usually range from 6-10, but state scores are not necessarily consistent across time. Additionally, because the measures vary each year, it is difficult to compare scores over time. Although this study is helpful for a general measurement of preparedness one year at a time, it does not focus directly on pandemic influenza, offers only ten measures for preparedness, and does not include consistent measures over time.

In 2007, the Congressional Research Service (CRS) published an assessment of state pandemic planning activities utilizing 66 factors in eight overarching areas including leadership and coordination, surveillance and laboratory activities, vaccine management, antiviral drug management, other disease control activities, communications activities, health care services, and

other essential services. It is not clear from where the measures used to evaluate plans came or upon what they were decided. Each state's plan was coded with a dichotomous yes/no measure of whether the factor was included (Lister & Stockdale, 2007). Researchers found that many states addressed core public health functions such as surveillance or vaccine management, but few plans addressed leadership and coordination, or the continuity of non-health services. This study was the most extensive analysis of written pandemic plans to-date, but is not reliable as the measures are not clearly evidence or expertise based. Additionally, this study's dichotomous measurement excludes nuances in the plans.

The National Governor's Association (National Governors Association, 2008) completed an extensive assessment of pandemic preparedness in all fifty states focusing on healthcare, commerce, education, and public safety; however, the assessment evaluated activities rather than written plans. The authors concluded that states are not fully prepared for a pandemic based on the evaluation they conducted; however the nation is more prepared than it was before the federal government offered guidelines and resources to support planning activities. Gaps remain in reaching non-health sectors of government and the private sector. Additionally, the report concluded that the progress made is in jeopardy of being lost due to skepticism about the threat of a pandemic, complacency among the public and government leaders, competing priorities, and declining funding. This report is helpful in understanding the activities undertaken by government agencies in pandemic planning; however, the report was based on responses from program participants and observations by researchers, both of which include inherent biases. Additionally, the focus of this analysis was the interaction between health and non-health agencies in the four areas noted which excluded numerous public health planning activities.

Most recently, in 2008 the CDC conducted a review of state preparedness planning and activities (Centers for Disease Control and Prevention, 2008). The report outlined progress and gaps in all 50 states and also described state specific information. The report focused on disease detection and investigation, public health laboratories, and response. Findings showed that public health department strengths included improved detection and investigation of diseases through improvements in the public health workforce and data collection and reporting systems. States also developed response plans, implemented a formalized command structure, and conducted exercises. However, weaknesses remain in a number of areas including recruitment of epidemiologists, lab capacity, legal framework, laboratory workforce, communication systems, and trainings.

The 2008 CDC evaluation is the most comprehensive review of state preparedness activities to date; however, written plans are not included in the report. The authors explained that the report only offers only a piece of what is necessary to truly evaluate preparedness. Replication of the report is challenging, as many of the data sources for this evaluation are not publicly available. The evaluation may also include biases as the CDC reviewed activities that were funded by the agency. While this review offers a great deal of information, the measures are not clearly defined, and the report does not include an evaluation of why some states are more or less prepared than others. Understanding why some states are more prepared than others offers important insight into the ability for public health systems to be effective.

Previous evaluations offer information about state preparedness; however, overall there are some consistent flaws that need to be addressed in future preparedness research. The lack of defined measures is problematic for measuring preparedness longitudinally. The tools used in prior studies all offer cross-sectional snapshots of state preparedness, but the measures do not

allow for evaluation of progress over time either because they are not clearly defined (Holmberg, et al., 2006), or the measures change in each evaluation (Levi, et al., 2008b). Additionally, written plans are excluded in most of the studies (Centers for Disease Control and Prevention, 2008; Levi, et al., 2008b), and the evaluations that focused on written plans (Holmberg, et al., 2006; Lister & Stockdale, 2007) did not explain the methodologies used to evaluate such plans.

Another key challenge in measuring pandemic preparedness is that many preparedness evaluations focus on preparedness for all-hazards. While there are some issues that are consistent in preparedness for any emergency (Perry & Lindell, 2003) pandemics are unique because they last longer than most emergencies and require community mitigation strategies such as social distancing, isolation, and quarantine (United States Department of Health and Human Services, 2007). These unique attributes make evaluating pandemic planning by itself a priority. The other gap in the assessments noted here was that none of the evaluations considered why some states are more prepared than others. The assumption has been that funding and preparedness are directly correlated, but there is no evidence to support that assumption.

The extensive public investment in pandemic planning has led to an expectation by elected officials, policymakers, and the public that states are prepared (Lurie, Wasserman & Nelson, 2006). Such investment has influenced changes in public health including working with new partners, experiencing changes in the workforce, utilizing new technologies, integrating preparedness with other public health functions, changing leadership and increasing accountability (Lurie, et al., 2006). However, previous research, although flawed, shows that gaps still remain. States that are under-prepared need guidance to improve upon the gaps, but without defined measures, priorities for improvement are unclear. Recently, the Institute of Medicine (IOM) (2008) reiterated the difficulty in objectively measuring the progress that has

been made and the gaps in preparedness. The IOM concluded that the future of public health preparedness requires criteria and metrics that enable public health systems to achieve continuous improvement and demonstrate the value of society's investment.

Current Study

The study described here focused on written plans because they are the initial step in preparedness activities and can offer evidence of states' consideration of federal recommendations. Emergency preparedness is not dependent upon written plans alone, but a variety of elements that must come together under very specific circumstances. However, written plans document the response activities and protocols generated by the planning process and practiced via trainings and exercises (Perry & Lindell, 2003).

The purpose of this study was to evaluate states' pandemic plans, as measured by the integration of CDC recommendations in their written pandemic plans. The current study addresses limitations of previous preparedness evaluations and offers two advantages over previous studies. First, clear measures of preparedness as defined by the expertise and experience of infectious disease experts in the Centers for Disease Control and Prevention's State and Local Pandemic Planning Checklist (Centers for Disease Control and Prevention, 2006c) were used. The use of clear, defined measures will allow this tool to be replicated over time and by various researchers, rather than redefining preparedness with each evaluation. Additionally, the tool utilizes a three point scale which captures nuances in plans ignored by a dichotomous yes/no measurement, allowing reporting of greater variation in plans and clarifying recommendations for improvement. The significance of this study lies in its ability to construct a baseline of information regarding state written plan comprehensiveness, and therefore a concrete step towards revising and improving plans.

The research conducted in this study addresses Healthy People 2010 priority areas for Public Health Infrastructure and Environmental Health related to research on public health systems to help communities respond to and recover from disasters and for disaster preparedness plans and protocols (United States Department of Health and Human Services, 2000). Additionally, this project advances the public health systems research agenda (Lenaway, Halverson, Sotnikov, Tilson, Corso, et al., 2006) by evaluating how shifting policy and financial priorities affect performance of the states' public health systems in terms of pandemic planning.

Research Question 1: To what extent have states incorporated federal recommendations from the CDC into their written pandemic influenza plans?

Objective 1: Develop a state pandemic plan assessment tool based on the CDC's State and Local Pandemic Planning Checklist (2006c) to evaluate whether states' most recent written publicly available pandemic flu plans address minimum federal recommendations for state preparedness planning. *Measurement Tool*

The CDC's State and Local Pandemic Influenza Planning Checklist (2006c) offers guidelines for pandemic preparedness and response and includes all of the components of emergency management programs (Perry & Lindell, 2003). CDC guidelines offer expertise-based minimum recommendations to ensure states have at least begun to consider all of the factors that go into a pandemic response. Although states may implement their plans differently, those that do not meet the minimum requirements will be less capable when responding to a pandemic as many of the factors may not have been considered or adequately addressed prior to the event.

Being able to measure a state's pandemic preparedness level can offer states a quantitative evaluation of their written plan's comprehensiveness and can help policymakers make a case for increasing state focus on preparedness activities. The methodology used here could be easily replicated for other areas of public health systems research in order to assess federal recommendations' impacts on state and local agency behavior. Although states may address the recommendations differently based on their individual needs, the overall recommended focus areas should be consistent across state plans.

The current study utilized the *inventories and capacity instrument* means of evaluating preparedness and developed a standard for assessing whether states meet the CDC recommendations for pandemic planning in their written pandemic plans. Inventory and capacity measures often suffer from a lack of clear structure and priorities because some tools include hundreds of specific items (Maldin, Lam, Franco, Press, Waldhorn, et al., 2007) which requires extensive time and resources and may cause the big picture to get lost in the details (Stoto, et al., 2008). On the other hand, short instruments (Levi, et al., 2008b) offer a succinct set of tools, but may lack enough specificity to assess differences in preparedness levels across jurisdictions or over time (Stoto, et al., 2008). However, the tool utilized in this study offers a balance of comprehensiveness and ease of use that addresses the limitations of previous inventory and capacity instruments.

The CDC's State and Local Pandemic Influenza Planning Checklist (2006c) (Appendix A) was turned into a matrix consisting of 10 domains made up of 85 factors to evaluate whether states' most recent publicly available written pandemic flu plans address minimum federal recommendations for state preparedness planning. The measurement tool utilized here allowed for easier comparison of state plans through clearly defined measures. Based on previous reviews

of state preparedness (Holmberg, et al., 2006; Trust for America's Health, 2006) it was expected that there would be variation between states with this new measure.

Measurement tools are generally evaluated and selected on the basis of a) validity, the extent to which they really measure the attributes they seek to measure; b) reliability, the extent to which they provide consistent measures over time and across raters; c) feasibility, the extent to which the measures are user-friendly and do not impose excessive burdens; and d) utility, the extent to which they support decisions related to improvement, accountability and other functions (Lurie, 2007; Nelson, et al., 2007).

This is the first time this tool was used, and some of these issues can only be addressed with additional research; however, this assessment offers the potential to meet all of the criteria for strong measurement tools. Construct and face validity can be inferred because the measures come from the authoritative agency on infectious diseases in the United States (Centers for Disease Control and Prevention, 2006a). Additionally, because the CDC is located in the United States, checklist items would have already taken into consideration the culture and needs of Americans as opposed to checklists offered by international agencies. The tool's validity may be confirmed in later studies via comparison to the initial evaluation to determine if the measurement tool holds up over time and through changes in state pandemic preparedness plans. Additionally, if a pandemic does erupt, the actual response to it can be compared with the level of preparedness captured in this measure. A survey could also be administered to state health departments with the same checklist to assess the consistency between survey responses and the text analysis measurement.

Like validity, the measure's reliability can be better confirmed with additional studies. There is currently no gold standard by which to judge this evaluation; however, results were consistent

between multiple coders which support the objectivity and reliability of the measurement tool. Additionally, comparing tests over time does not ensure reliability of the measurement tool because each plan is a living document that will change. However, the tool can be used to evaluate if states become more prepared between evaluations.

The measurement tool met the criteria of feasibility because it was a simple checklist with a three point scale. Although the process of coding state plans was time consuming, it was not particularly complicated or difficult. Utility was clear in that the measures supported the recommendations offered by the federal government to states regarding their pandemic influenza plans. There is often overlap and conflict in federal agency recommendations surrounding emergency preparedness (Lurie, et al., 2006; Nelson, et al., 2007). The instrument created here could reduce disparities between recommendations from various agencies. If all states used this measure to identify weaknesses in their preparedness plans, the CDC could update their checklist when an appropriate new guideline was implemented or proposed. The use of a single, agreed-upon tool in the preparedness community would allow states to aim for a specific target, rather than adjust their plans based on varying measurement tools and recommendations, thereby creating disparities among plans and measurements of preparedness.

The tool was also advantageous because all states were evaluated in a relatively short period of time. Rather than survey each state, levels of plan preparedness were collected and easily compared. Additionally, checklist items allowed for relatively straightforward and easy data analysis, including the calculation of aggregate measures of central tendency and variation and comparison across subgroups (Nelson, et al., 2007).

The tool is not meant to offer an evaluation of all pandemic preparedness activities in every state; however, it does offer an overview of whether or not written plans integrate all of the

recommendations put forward by experts at the federal level. Although there is a limited evidence base for pandemic preparedness, this particular measure has been chosen because the CDC is the authority on infectious diseases in the United States and offers the most comprehensive recommendations for pandemic planning at the state level. The measurement tool created in this study was unique in that most assessments of state preparedness plans are completed by state officials through surveys (Centers for Disease Control and Prevention, 2008; National Governors Association, 2008). Often, different officials complete different parts of surveys and have different understandings of their plans (Lurie, 2007; Nelson, et al., 2007). The measurement tool used in this study offers a clearly defined assessment of states' plans, without the variation due to differences in the positions and perspectives of the individuals filling out the reports. The likelihood of large numbers of ill during a pandemic increases the likelihood that substitute staff may be implementing a pandemic response. It is important that written plans reflect actual planning processes so replacement staff may be able to implement an appropriate response.

Given the variation in state plans, this study sought not only to assess state levels of written plan preparedness, but also to understand why some states integrate more federal recommendations than others. Nelson's structure-process-outcome framework (Nelson, et al., 2007), although helpful in assessing preparedness after an event has occurred, cannot be used to measure preparedness levels prior to an event or the factors that predict increased preparedness. The interest in understanding what makes plans comprehensive led to the next research question.

Research Question 2: What factors best predict the inclusion of federal recommendations in state pandemic plans?

Objective 2: Employ political theory in order to evaluate the factors that influence pandemic plan inclusion of federal recommendations.

Theoretical Framework

Bureaucratic agencies are defined by four characteristics: 1) they are large and the highest ranking members know less than half of the employees; 2) a majority of their members are full-time employees who depend upon employment for their income; 3) hiring, retention, and promotion decisions are based on performance rather than arbitrary characteristics (race, gender, etc.) or periodic elections; and 4) the majority of their outputs are not evaluated by markets external to the organization (Downs, 1967; Wilson, 1989). State health departments are bureaucratic agencies charged with responsibilities that include policy making, priority setting, data collection and analysis, financing, and oversight of local public health activities (Wall, 1998). Health departments are the state bureaucratic agency charged with creating, maintaining, and practicing state pandemic influenza plans.

State policy is often determined by the characteristics of the organization responsible for implementing the policy effort (Whitford, 2007). Understanding bureaucratic behavior and policymaking continues to be a challenge for political science and public policy researchers. Studies have linked bureaucratic behavior to human behavior theory (Schmidt, 2000), pressure from different branches of government (Wood & Waterman, 1994), internal hierarchical relationships (Downs, 1967; Ford, Duncan & Ginter, 2003), interest groups (Moe, 1990), resources (Pfeffer & Salancik, 2003), and political support (Rourke, 1984; Spiller & Tommasi, 2003).

There are four key areas of bureaucratic behavior: regulatory policy, redistributive policy, distributive policy, and constituent policy. Regulatory policy is "government restrictions of individual choice to keep conduct from transcending acceptable bounds (Meier & Bhote, 2007, pg. 76)." Regulatory policy includes restriction of criminal activity, regulation of American business, limiting access to public goods, and public health and safety regulations such as inspections of business, products, and drugs as well as sanitation and vaccination (Meier & Bhote, 2007). Much of the public administration literature about bureaucratic behavior focuses on regulatory policies and the influence of external agents such as interest groups, legislatures, and the President on policymaking (Joskow, 1974; Noll, 1985; Scholz & Wei, 1986; Spiller & Tommasi, 2003; Weingast & Moran, 1983; Whitford, 2007).

While regulatory policy restricts behavior, redistributive policy focuses more on service provisions as it taxes one group of people in order to provide benefits for another group (Meier & Bhote, 2007). Five major areas of public policy are classified as redistributive including income stabilization, welfare, health care, housing, and income distribution. At the federal level, redistributive polices rarely provide services to the public and state and local agencies that administer such programs have a great deal of discretion (Meier & Bhote, 2007). Research in this area has focused on the political predictors of redistribution policies (Dye, 1969; Jennings, 1979) which include legislative and executive oversight, and efficiency of redistributive policies (Warner & Hefetz, 2002).

Distributive policy is similar to redistributive policy and is the most common form of government action to solve public problems. Such policies use general tax revenue to provide benefits directly to individuals, rather than redistribute financial resources. Examples include parks, health research, crop insurance and urban grants (Meier & Bhote, 2007). Agencies that

focus on distributive policies have more policymaking influence than other bureaus because they focus on maximizing distribution benefits. However, adjudication and rulemaking, areas of focus for other bureaus, are not major activities for distributive agencies (Meier & Bhote, 2007). Research has noted that distributive agencies are under the influence of representative legislature (Weingast, Schepsle & Johnsen, 1981), are dependent upon electoral structure (Lizzeri & Persico, 2001); and vary depending on the demographic make-up of a community (Alesina, Baqir & Easterly, 1999).

The fourth policy type bureaucracies implement is constituent policy which is made up of policies that do not fit among the other three policy areas and include agencies that are massive and deliver services rather than money to procure services (Meier & Bhote, 2007). Two types of bureaus exist in this policy area: national security and government service bureaus such as the Office of Personnel Management. These types of agencies are also open to influences of government and politics. The key factor that influences whether these agencies will be subject to external influences is the degree to which the issue under consideration is subject to partisan debate (Harris, 1977). According to Harris (1977), if issues are not politicized, decisions are made at low levels in the bureaucracy, and if an issue is politicized, then decisional authority moves upward with politicians resolving issues and imposing uniform behavior on the bureaucracy.

While the research in all four areas of bureaucratic behavior is helpful in understanding how bureaucracies work, pandemic planning falls outside the four categories noted. Here, state health departments are creating plans that are speculative and may be activated at a later date. Upon plan implementation, the policies may be regulatory if movement is restricted, redistributive if funds are shifted to support health care costs for the uninsured, or distributive via mass

vaccination or antiviral distribution, but the plan alone is not a policy outcome or typical bureaucratic behavior. Pandemic responses could be constituent policies since they will likely include distribution of services at some point, but the planning process does not include distribution of goods or services. Bureaucratic agencies such as state health departments are given the task of formulating plans based on guidelines and their expertise and experience; however, this exercise is organized and conducted within the agency itself (United States Department of Health and Human Services, n.d.) and, unlike other policy types, does not include the distribution of resources outside of the agency.

Little research has been conducted to evaluate planning behavior to assess what factors are associated with it. Pandemic influenza plans were created by state health departments who have the authority to plan based on their expertise and federal planning recommendations. Here, the state health department bureaucratic behavior of developing a statewide pandemic influenza preparedness and response plan was evaluated. Planning behavior falls outside the lines of traditional bureaucratic behavior; therefore, it is important to understand what factors are associated with this type of behavior to ensure planning is comprehensive.

Theories of Bureaucratic Behavior

Funnel of Causality

In 1974, Richard Hofferbert developed a conceptual framework of the policy process modeling how a variety of factors influence public-policy outputs. The factors he included were seen as direct and indirect functions of historical geographic conditions, socioeconomic conditions, mass political behavior, governmental institutions, and most directly, elite behavior (Hofferbert, 1974; Mazmanian & Sabatier, 1980; Sabatier, 1991). Hofferbert saw these factors acting in a "funnel of causality" toward government decision-making (Figure 1). Pandemic flu plans are a policy

output by bureaucratic agencies, and this framework was initially considered to evaluate factors that are associated with variation in state plans.

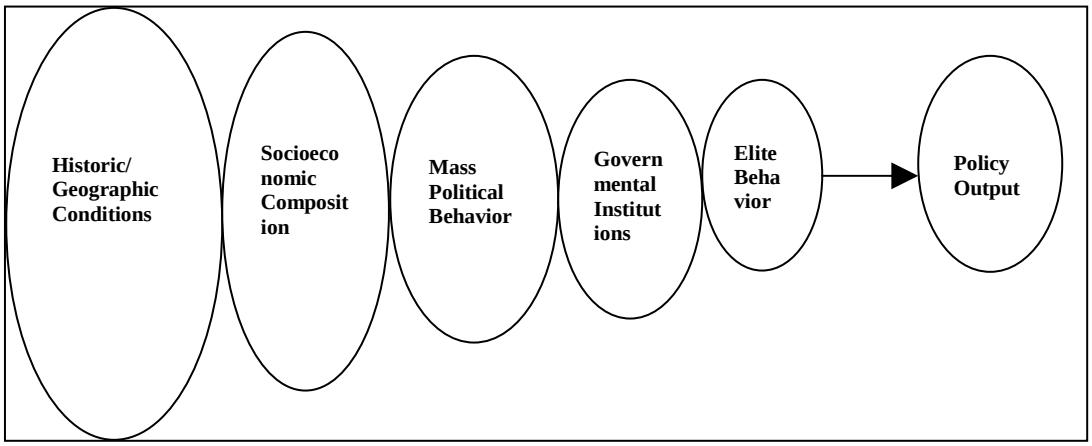

Figure 1. Funnel of Causality (Hofferbert, 1974)

Hofferbert's funnel is formulated in terms of two basic dimensions: time and importance. A decision is explained as the result of both direct and indirect forces; it proceeds from historical geographical conditions, the broadest and most distant sector, through the stages of socio-economic composition, mass political behavior, basic governmental institutions, to elite behavior in conjunction with the formal policy-conversion mechanism, and finally to public-policy outputs. The closer to the actual decision a policy moves, the more narrow range of variables (or actors) in each stage bearing upon it. This model is advantageous because it provides a reasonable theoretical criterion for ordering the entry of variables according to the succession of developmental stages from the most distant and encompassing characteristics to the most specific (Mazmanian & Sabatier, 1980). Using Hofferbert's funnel can offer assistance in understanding not only what factors are most important but also their relationship to each other. This can help policymakers prioritize what factors to address when trying to impact a policy output.

While Hofferbert's model is helpful for understanding a number of bureaucratic behaviors, the assumption that each input funnels into the next one can be challenging to evaluate. Causality between outcome variables and policy inputs can be measured, but the relationships between policy inputs (independent variables) can be more difficult to assess. Additionally, given the relative importance of each part of the funnel, it is difficult to tease out the factors that are of greatest importance, particularly without the impact of the other factors in the funnel. The current evaluation is the first assessment of factors that impact pandemic planning, and a simpler model is more appropriate for this initial evaluation; however, future research could assess whether Hofferbert's explanation of policy creation can explain pandemic planning.

Self Interest and Institutional Powers and Constraints Theories

Anthony Downs (1967) outlined two theories of bureaucratic behavior. The self-interest theory of bureaucratic behavior focuses on the idea that rational individuals make decisions based on self-interest maximization. Within this theoretical approach, self interest and the goals that make it up vary depending on where the bureaucrat sits within the organization, and what personal characteristics he or she brings to the job (Schmidt, 2000). Underlying outcome beliefs and outcome evaluations are the components of the self-interest calculations of bureaucrats. Bureaucrats will tend to have a positive attitude toward reform if their self interests are served and reform leads to a perceived positive outcome and a negative attitude if it leads to a negative outcome (Schmidt, 2000).

The theory of institutional rules and constraints attributes bureaucratic behavior to the institutional, organizational, and environmental context that bureaucrats operate in, rather than to their self-interest-determined behavior (Downs, 1967). These theories present a view that situational constraints—such as bureaucratic rules, and external oversight and control—dictate

behavior. Situational constraints are broadly defined as rules, or any formal or informal guidelines, controls, or constraints that dictate or influence behavior (Schmidt, 2000).

For the initial evaluation conducted in this study, understanding pandemic plans as a result of institutional behavior was the focus of interest, rather than individual bureaucratic behavior. While individuals are important in both planning and response, health departments were given funding and guidance specifically for state-wide pandemic planning. Evaluating if structural and institutional factors were associated with the agency behavior of plan creation was the initial is useful in understanding bureaucratic institutional behavior. However, future studies could evaluate the impact of individual bureaucrat's behavior on pandemic planning.

Organizational Capacity, Overhead Political Control, and Task Environment

Three theories that describe bureaucratic institutional behavior offered the most comprehensive and easily comparable explanations for the type of bureaucratic behavior in question here: organizational capacity, overhead political control, and task environment. There has been a variety of research that helped to guide the use of these three models for explaining the outcome of interest in this study.

Keiser (Keiser, 1999) found that the variation in the implementation of the Social Security Disability program at the state level is a function of levels of need for benefits, the health of the economy, and state partisan politics.

> In short, disability rates at the state level are a function of the economic environment (unemployment rate), the task environment (aged population and percent of employees working in manufacturing), and the political environment (Democratic control of state legislatures). (Keiser, 1999, pg. 100)

Street-level bureaucracies, public agencies that work directly with citizens (Lipsky, 1978), seem open to influence from political officials, but they do not respond to fiscal stress on state

governments or to high levels of social commitments measured by public assistance rates for aid to needy families and social security insurance (Keiser, 1999).

Similar to the Social Security Disability program, it was expected that pandemic planning was a function of external factors including economics, demographics, and external political actors. Whitford (2007) compared organizational capacity, overhead political control, and task environment models to evaluate the bureaucratic implementation of policies governing the remediation of hazardous waste at the state level in the United States. The comparisons of the three models showed that bureaucratic preferences are best explained by the organizational capacity model rather than the political and task environment theories, at least for regulatory activities. Similarly, an empirical test using a public education data set showed that bureaucratic values (organizational capacity) are far more influential in explaining bureaucratic outputs and outcomes than political factors (Meier & O'Toole, 2006).

The themes noted in these theories have been used by multiple researchers (Downs, 1967; Keiser, 1999; Meier & O'Toole, 2006; Whitford, 2007) to evaluate bureaucratic behavior. The output in this study is not a policy or even an activity, but rather a plan to be implemented in the event of an emergency. The research conducted in this study is the first time such models have been used to explain planning behavior; all three models of interest were tested. It was hypothesized that the ability of state health departments to create comprehensive pandemic preparedness plans was associated with organizational capacity, overhead political control, or task environment explanations for bureaucratic behavior.

Organizational capacity. The organizational capacity framework suggests that an agency's organizational attributes including its rules, regulations, and reward mechanisms determine its decisions (Downs, 1967; Thompson, Shay, Weintraub & al., 2003) (Figure 2).

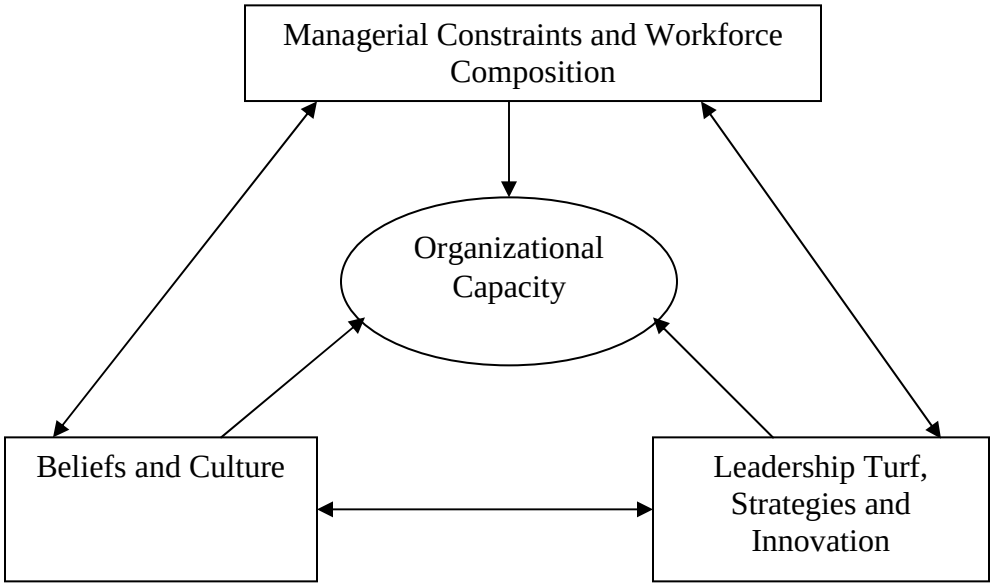

Figure 2. Organizational Capacity Model of Bureaucratic Behavior

There are three overarching areas that make up the organizational capacity framework: an organization's beliefs and culture; managerial constraints and workforce composition; and its leadership's turf, strategies and innovation influence the outcomes of an organization (Wilson, 1989). Each of these areas may be more or less important depending on the issue at hand, but they all work together to impact organizational capacity. Specific factors that influence organizational capacity include organizational resources, rules and tools, and incentives and control mechanisms.

An organization's beliefs and culture is defined as the shared beliefs and values guiding the thinking and behavioral styles of members (Cooke, 1988). Factors in this area may include staff education levels, work hours, and collegiality in an organization among other things. Analyzing the culture of state health departments specifically was beyond the scope of this study; however, future studies could collect qualitative data to better understand state health department culture and its impact on pandemic preparedness.

Managerial constraints and workforce composition shape what bureaucratic agencies are able to accomplish. Organizations have limits that include the following:

> (1) cannot lawfully retain and devote to the private benefit of their members the earnings of the organization, (2) cannot allocate the factors of production in accordance with the preferences of the organization's administrators, and (3) must serve goals not of the organization's own choosing. (Wilson, 1989, pg. 115)

Leadership's turf, strategies, and innovation can be thought of as the autonomy of an agency as defined by its independence to conduct business without external influence or obligations (Wilson, 1989). Agencies with reduced oversight by legislatures and courts have increased autonomy; however, it the responsibility of state legislatures to define the level of autonomy bureaucratic agencies possess (Gostin, 2002). Government agencies require appropriations and personnel, but also political support. Political support is highest when an agency's goals are popular, its tasks simple, its rivals nonexistent, and the constraints minimal. Agency autonomy ranks high when it has few or no bureaucratic rivals, a minimum of political constraints imposed on them by superiors, and a widely shared and approved understanding of the central tasks of the agency. Agencies are most comfortable when they can define their roles and are not forced to take on additional responsibilities. New strategies and innovations are the enemy of the status quo. Most agencies are created in order to maintain stability and routine, particularly in the public sector (Wilson, 1989). In this evaluation, all state health department roles in written pandemic plan creation were consistent – all state health departments created their states' plans; however, the resources necessary to do so varied.

The theory of organizational capacity addresses how internal organizational structure and restraints impact bureaucratic behavior. Of the three models offered here, organizational capacity is the only one that focuses strictly on the internal structures and processes of a bureaucratic

agency. Organizational capacities and constraints that lock an agency into a choice, such as funding constraints, dictate bureaucratic preferences (Whitford, 2007). Although bureaucracies are at the mercy of external political and environmental influences, it is the internal capacity that will impact policy making, implementation, and regulation (Whitford, 2007). Bureaucratic agencies that are charged with particular tasks, but lack the capacity to implement them will be less successful.

For the purposes of this evaluation, organizational capacity focused primarily on the resources necessary for a health department to create a comprehensive written pandemic plan. Organizational resources (staff, funding levels, and funding sources) constrain bureaucratic preferences. Specific constraints include the number of staff associated with a program, number of funding sources a program has and total funding for the program. Resources are the overarching theme impacting the boxes noted in Figure 2. Managerial constraints are directly linked to funding levels as reduced funding will limit the amount of planning that can be completed. Workforce composition is directly measured by staff levels. Beliefs and culture, while more difficult to measure, are impacted by the resources an agency has to complete its work. Similarly, strategies and innovation are impacted by resources as limited resources will minimize innovation. Planning is an internal process, and the resources necessary including funding and staff levels were considered the most important variables to include in the model as they would be necessities in plan creation. This same model could be used to evaluate response activities and include more of the other factors that make up the model.

Hypothesis 1: Organizational capacity, as measured by state resources for emergency planning, will be the best predictor for the inclusion of federal recommendations in states' pandemic influenza plans.

Overhead political control. The overhead political control model suggests that the preferences and influences of external political forces determine the decisions of an agency. Here, bureaucratic preferences are centered on the hierarchical role of political actors including legislators, governors, and the President (Ford, et al., 2003; Ringquist, 1995; Wood & Waterman, 1994). The mechanisms for control include the legislature (Brudney & Henert, 1987; Huber & Shipan, 2000; McCubbins & Schwartz, 1984; Weingast & Moran, 1983; West, 1995) and the executive branch as they create policies that bureaucratic agencies enforce (Moe, 1989) including business (Noll, 1971), environmental (Joskow, 1974), occupational health (Scholz & Wei, 1986), and trade (Weingast & Moran, 1983) regulations. Much of the work done in this area focuses on regulatory policy and the actions of regulatory agencies (Noll, 1985). The focus of overhead political control theory is that individual political actors and bodies define what bureaucratic agencies will do based on their desires manifested in the laws they create and enforce. Agencies may be encouraged to support executive actions via increased funding and legislative support of beneficial legislation, but they can also be forced to comply via mandates and executive orders (Moe, 1990).

The overhead political control model is particularly interested in external governmental forces and their impacts on bureaucratic policymaking and activities. Although bureaucratic agencies are a-political, political actors and parties have extensive control over agency priorities and resources. Public health agencies in particular are at the mercy of politicians as they set the agenda and emphasize policies that are politically expedient based on their individual or party perspectives and agendas. For example, the legislature may pass a budget that earmarks funds for chronic disease prevention and reduce funds for preparedness planning in state health departments. Such actions inherently change the priorities of health departments. While state

health departments have been charged with pandemic plan creation, the federal government stopped short of mandating what should be in state pandemic plans and instead offered funding and encouraged the utilization of federal recommendations in the creation of their plans.

In this evaluation, the focus was specifically on state-level government agents including the governor and state legislatures, as this is where variation in political leadership existed among states. Also, because state bureaucracies were charged with plan creation and will be charged with plan implementation, state leaders will be those influencing and carrying out plan objectives, and would therefore be most invested in state plan creation. Specific areas of interest and data collection that were thought to impact pandemic plan creation included political party in power, governor party and staff size, professionalization of the state legislature, and civic engagement as measured by voter turnout.

Hypothesis 2: Overhead political control, as measured by state political variables, will be the best predictor for the inclusion of federal recommendations in states' pandemic influenza plans.

Task environment. The task environment theory argues that the problems and situational imperatives facing an agency determine the choices it makes (Joskow, 1974; Noll, 1985; Scholz & Wei, 1986) (Figure 3).

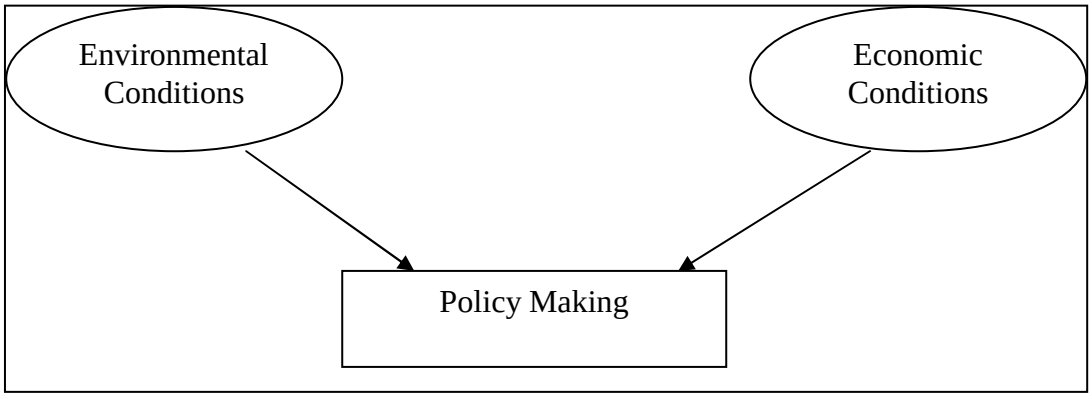

Figure 3. Task Environment Model of Bureaucratic Behavior

Bureaucrats respond to social problems and to circumstances external to their organizations (Scholz & Wood, 1999; Wilson, 1989). The task environment model claims that structural attributes of the environment frame bureaucrats' understanding of what they should be doing, how they should do it, and whether their actions have an impact (Whitford, 2007). Essentially, bureaucrats obtain information about their task via broad concepts of their states' economic and environmental circumstances (Brehm & Hamilton, 1996; Salemi, 1995). Task environment addresses how factors in the general environment impact bureaucratic agencies' effectiveness.

Public health agencies in general are directly impacted by environmental and economic conditions. State health departments depend on external resources funded by tax dollars, and they act as a safety net for many who do not have access to health resources. As tax revenue decreases in economic downturns, the public has an increased need for public health services (Holahan & Garrett, 2009). Bureaucratic agencies are at the mercy of external environmental factors including funding for public health programs (Levi, Vinter & Segal, 2008a), population characteristics (Holahan & Garrett, 2009), and revenue streams (Holahan & Garrett, 2009; Levi, et al., 2008a) for their subsistence and ability to fulfill their responsibilities. Economic and environmental conditions should also impact pandemic planning. Population density (Cohen, 1999; United States Department of Health and Human Services, 2007), number of uninsured (Holahan & Garrett, 2009), and income level (Cohen, 1999) all affect the spread of communicable diseases.

This study focused on specific factors that were most likely to be associated with pandemic planning based on vulnerability of populations and the state environment. In order to measure population vulnerability, Medicaid and Medicare expenditures, population density, and percent

urban were collected. Additionally, in order to better understand the fiscal environment of each state, median household income and revenue per capita were evaluated.

Hypothesis 3: Task environment, as measured by the situational imperatives facing an agency, will be the best predictor for the inclusion of federal recommendations in states' pandemic influenza plans.

Objective 3: Employ health department structural theory in order to evaluate the factors that influence pandemic plan inclusion of federal recommendations.

Health Department Structure

In addition to evaluating the three models noted above, additional questions about the internal factors that influence pandemic planning were of interest. Pandemic planning is a unique type of bureaucratic behavior, and it was necessary to look at internal organizational behavior for potential explanations for this type of behavior. There has been interesting research in the new and growing body of public health systems research literature which focuses on the behavior and activities of the public health system and its interaction with government, consumers, and health care agencies (Lenaway, et al., 2006). Included in this work was an evaluation of state health department structure (Ford, et al., 2003) that noted a variety of structural variables which had the potential to be useful in explaining pandemic planning. Many of these variables captured internal cultural components that were difficult to glean from the datasets used in the political model analyses. Since planning behavior is an internal process, it was suspected that data regarding the internal structure and processes of health departments would have a greater association with planning behavior.

In 1988, the Institute of Medicine (IOM) commissioned the report, *The Future of Public Health* where it identified and made recommendations regarding state and local health departments' core functions including assessment, policy development, and assurance. Other researchers and agencies have since offered additional guidance to public health agencies which expanded upon the IOM report (Centers for Disease Control and Prevention, 2000; Roper, Baker, Dyal & Nicola, 1992).

Roper et al. (1992) noted in 1992 that although progress had been made since the IOM report's release, the public health system still had to focus on five critical needs: increasing the knowledge base of public health workers, dynamic leadership from public health officials and agencies, access to data, disease prevention and health promotion plans, and funds for prevention programs. Almost ten years after Roper's report, the Centers for Disease Control and Prevention (CDC) updated the key goals and recommendations for public health's infrastructure including a skilled workforce, robust information and data systems, and effective health departments and laboratories (Centers for Disease Control and Prevention, 2000). There have been studies both at the local (Miller, Moore & Richards, 1993; Scutchfield, Beversdof, Hiltabiddle & Violante, 1997a) and state levels (Centers for Disease Control and Prevention, 1994; Scott, Tierney & Waters, 1990; Tierney, et al., 2001) in order to evaluate the progress of health departments since the 1988 IOM report was released.

Local Health Departments. In order to evaluate changes in local public health departments' progress after key events in the 1980's Miller et al. (1993) surveyed a select group of high performing local health departments over a decade. Case studies showed that local health departments improved assessment and policy development; however, they had extensive challenges including loss of Federal grants, increased demographic changes, substance abuse,

and economic downturn. Local health agencies were also found to show improvements in areas such as education of the public and outreach towards legislators and voluntary health organizations, but shortcomings included a low level of implementation of the recommendations, with restricted authority and lack of support also contributing to the problem (Scutchfield, et al., 1997a; Scutchfield, Hiltabiddle, Rawding & Violante, 1997b).

State Health Departments. Like local health departments, state health departments agreed with the IOM report regarding critical public health activities of assessment, policy development, and assurance of access to services (Scott, et al., 1990; Tierney, et al., 2001). State health departments have met some of the IOM goals including the establishment of separate departments of health from other bureaucratic agencies, agreed-upon public health duties, outreach, infrastructure, and scope of responsibilities. However, states have reported that the function of policy development is an area that is lacking (Scutchfield, et al., 1997a). There have been core changes in the structure and functions of state public health systems over the past decade, and understanding the impact of such changes is necessary to evaluate public health system performance (Beitsch, Brooks, Grigg & Menachemi, 2006; Wall, 1998).

While pandemic influenza planning is not a policy outcome in the traditional sense of regulatory, redistributive, or distributive policies (Meier & Bhote, 2007), it is a behavior that will influence response policies in the event of a pandemic. States' challenges with policy development in other areas may be consistent with challenges in pandemic planning, and understanding the structural factors that influence pandemic planning can be used to address other policy challenges.

Classifying Organizations. Classifying organizations can help to evaluate their behaviors and outcomes. There are two primary approaches to classifying organizations: typologies and

taxonomies (Duncan, Ginter, Rucks, Wingate & McCormick, 2007; Ford, et al., 2003). "Typologies identify multiple ideal types, each of which represents a unique combination of the organizational attributes that are believed to determine the relevant outcomes" (Doty & Glick, 1994, pg. 232). Typologies have been described as deductive or intuitive approaches and are developed by setting forth broad principles and laws to explain the behavior of empirical objects {McKelvey, 1975). Unlike classification systems, typologies are intended to predict the variance in a dependent variable because organizational types identified in typologies are developed with respect to a specified organizational outcome (Doty & Glick, 1994).

Taxonomies, on the other hand, are used to characterize the results of empirical multivariate-inductive-analyses (McKelvey, 1975). The taxonomic approach focuses on selecting a set of organizations and empirically deriving a method of classification (Ford, et al., 2003). Taxonomies have often been defined as classification systems (McKelvey, 1975); however, this has led to confusion because classification assumes an either-or proposition. Classification poses challenges when defining organizations as they have so many attributes; mutually exclusive categories are not practical and do not appropriately describe organizational attributes (McKelvey, 1975). Taxonomies are actually more complex than simple classification schemes as they express similarities between organizations in a hierarchical fashion (Rich, 1992). The most important feature of any configuration or classification is determining the purpose of the organizations being analyzed. Ford et al. (2003) utilized configuration in qualitative research in order to identify taxonomies for describing state health department structure.

The taxonomies Ford (2003) and his colleagues configured were based on cluster analysis after extensive qualitative evaluations of state health department materials. The clusters Ford et al. defined included: flexible agencies in unpredictable environments, centralized and stable,

complex solutions and chaotic environments, incremental change in bureaucratic environments, and scarce resources for slow change. While Ford et al.'s evaluation was helpful in classifying health departments; the raw scores of the variables were used here in order to evaluate their association with state pandemic plans for a number of reasons. First, the definitions of the clusters, although appropriate for Ford et al.'s work, were not definitive enough upon which to base this analysis, and they assumed mutual exclusivity, whereas, here, it was believed that many of the variables could overlap between clusters. The clusters also had varying numbers of states within them (2-18) making comparison across clusters difficult.

Methods

Dependent Variable

Written plans for the 50 United States were collected; 49 states' complete pandemic plans were publicly available on the web site www.pandemicflu.gov or the Council of State and Territorial Epidemiologists web site (http://www.cste.org/). North Dakota was contacted for its complete plan; however, the state preferred that the 2006 publicly available plan summary, available on the State Health Department web site, be used. Plans spanned from 2004-2007.

The plans were read and coded; each recommendation had an interval measure of no mention (1), brief mention but no description or action item associated with the factor (2), or in-depth description of the item (3). For example, if a plan mentioned that risk communication was important, but did not explain assessment of communication needs, it received a score of 2; if the plan explained coordination with public partners, it received a score of 3 for that individual factor.

The three point scale was used in order to capture nuances in the plans that would not have been clear had a dichotomous scale been used. Previous studies (Levi, et al., 2008b; Lister &

Stockdale, 2007) have used dichotomous measures, but it was not clear if the areas of interest were addressed to the same extent in every state. By including a three point scale, more information was gleaned about the planning process and comprehensiveness of the plans. Initially the use of a five point scale was considered, but the difference between scores would have been difficult to define clearly, and such scoring would not have offered additional substantive information as the goal was to evaluate trends overall, rather than specific factors under each domain. It was assumed that the distance between each interval was equal, and data were treated as interval, rather than categorical data. Future studies can evaluate the distance between scores more deeply or utilize the measures as categorical, rather than interval data to test this assumption.

Each state's domain scores were calculated by adding the scores of each factor within the domain. For example, the leadership and networking domain included 18 factors with 3 possible integer scores (1, 2, and 3) resulting in a total possible domain score equal to 54. Each 1, 2, and 3 was added together to calculate a domain "raw score." The raw scores were those used in each of the analyses throughout the study. In order to gain an understanding of average scores (percentage scores) in each domain (Chapter 2), the domain "raw scores" were divided by the total possible score for each particular domain. In order to create a "total preparedness score" for each state, the unweighted scores of each domain were added together. For descriptive purposes, each state's total score was divided by the total possible score and a percentage was derived. Again, raw "total preparedness scores" were used for all of the evaluations. Previous measures have not applied weighting to their evaluations of multiple preparedness indicators (Centers for Disease Control and Prevention, 2008; Holmberg, et al., 2006; Lister & Stockdale, 2007), and it is not clear that any of the domain areas is more important than others. Future studies,

particularly those conducted after such an event, could weigh domains based on their importance in practice.

Independent Variables

To evaluate the three political theory models' association with state pandemic preparedness, measures thought to best operationalize each theoretical model were collected and assessed for their individual and collective association with preparedness. See Table 2 for a list of variables, measurement, and data sources.

Table 2. Independent Variables, Measurement, and Data Sources

Model	Variable	Measure	Data Source
Organizational Capacity	Health Expenditures per 1,000	$	Book of States(Council of State Governments, 2007)
	Emergency Management Funds per 1,000 (2003)[1]	$	Book of States(Council of State Governments, 2007)
	EMA FTE per 1,000 (2003)	Number	Book of States (Council of State Governments, 2007)
	Cooperative Agreement Funds per 1,000 (2003)	$	Book of States (Council of State Governments, 2007)
	Federal aid for disaster relief per 1,000 (2003)	$	Book of States(Council of State Governments, 2007)
	Federal aid to sate emergency management planning and assistance per 1,000 (2003)	$	Book of States(Council of State Governments, 2007)
	Health Commissioner Salary per 1,000	$	Book of States(Council of State Governments, 2007)
	Federal Expenditures on DHHS salaries and wages per 1,000 (2003)	$	Book of States(Council of State Governments, 2007)
	Federal Expenditures on DHHS grants per 1,000 (2003)	$	Book of States(Council of State Governments, 2007)
Overhead Political Control	Governor involved in EMA appointment?	Y/N	Book of States(Council of State Governments, 2007)
	Governor involved in Health Commissioner Appointment	Y/N	Book of States(Council of State Governments, 2007)
	Voter Turnout (2000)	% turnout	Book of States(Council of State Governments, 2007)
	Governor Salary	$	Book of States(Council of State Governments, 2007)
	Governor Staff	Number	Book of States(Council of State Governments, 2007)
	Partisanship of Governor	1=Democrat 0=Republican	Book of States(Council of State Governments, 2007)
	Size of Dem compared to Rep in state house	Percentage	Book of States(Council of State Governments, 2007)
	Size of Dem compared to Rep in state senate	Percentage	Book of States(Council of State Governments, 2007)
	Professionalism	Score	King(King, 2000)
Task Environment	Population Density	# people	Census (year before plan implementation) (United States Census Bureau, n.d.-b)
	Urban population	Percentage	Census (year before plan implementation) (United States Census Bureau, n.d.-b)
	Per Capita Medicaid Expenditures	$	KFF (The Henry J. Kaiser Family Foundation, n.d.)
	Per Capita Medicare Expenditures	$	KFF (The Henry J. Kaiser Family Foundation, n.d.)

[1] All 2003 data were adjusted for inflation to the year before the plan was published.

	Median Household Income	$	Census (United States Census Bureau, n.d.-a)
	Total State Revenue per 1,000	$	Census (United States Census Bureau, n.d.-c)
	% Uninsured	Percentage	KFF (The Henry J. Kaiser Family Foundation, n.d.)
	Per Capita Income (2003)	$	Census (United States Census Bureau, n.d.-a)

All data were collected for the year before the plan was created; state plans varied across a span of three years (2004-2007). The variables for which such data were not available utilized data points from the years noted in Table 2; however, all financial data were adjusted for inflation using the Bureau of Labor Statistics conversion calculator for the year before the plan was implemented. Most data that were not available for the year before plan creation were available from 2003; however, voter turnout was collected from 2000 in order to capture presidential election voter turnout, and King's (King, 2000) legislative professionalism scale was from 1993-1994. This particular scale was used because it was continuous whereas many other professionalism scales include rankings that would have meant the analysis on this variable would have differed from other variables. Per 1,000 people data were calculated by dividing data points by population levels for the year before the plan was implemented and multiplying by 1,000. Right skewed data was transformed logarithmically.

Additional Variables

At the start of this project, there were additional variables that were of interest, but could not be accessed. Under organizational capacity, information about the existence of a public health preparedness office for each state would have been helpful; however, it was not clear when such offices were established (before or after the plan) and many states have hybrid offices where preparedness is a department but part of another division. Initially state budgets were reviewed to

gather data about state allocations for preparedness and state laboratories; however, this data cannot be gleaned from state budgets for a number of reasons. First of all, not all budgets are annual; many are bi-annual making comparisons across states difficult. Additionally, most state budgets do not parse out funding appropriations in such a specific way. For example, state budget appropriations for the public health departments may be reported, but line items for specific activities are rarely present. Additionally, appropriations did not offer as much information as expenditures because money that is appropriated for a specific task may not be spent that way. Data regarding trends for seasonal influenza by state were also of interest; however, the CDC only offers regional data that would have been difficult to separate among states in each region.

There were similar challenges collecting data for overhead political control and task environment variables. For overhead political control, data on whether or not health departments control pandemic influenza appropriations was of interest, but this data is not available from state budgets or the Book of the States (Council of State Governments, 2007). For the task environment model, operations appropriations and expenditures for state health departments would have been helpful but such data are not included in state budgets.

Data Collection

The data noted in Table 2 were all publicly available data via secondary sources. Data were primarily collected from three sources. *The Book of the States* has been compiled annually since 1935 by the Council on State Governments and contains essential information from each state and territory in summaries, tables and charts (Council of State Governments, 2007). Financial, staff, and legislative data were all collected from this source.

Census data were used for population, demographic, revenue, and income data. Most of this data were available for the year before plans were implemented except for per capita income data which was adjusted for inflation from 2003 dollars to the year before the plan was implemented. All plans were created after 2003.

Data including Medicaid expenditures, Medicare expenditures, and the percent of the population that was uninsured were collected from the Kaiser Family Foundation which offered multiple years of data by state. All of this data were available for the year before plan implementation.

One additional data source was used for one of the variables. King's professionalism scale from the article "Changes in Professionalism in U.S. State Legislatures" (King, 2000) was used to measure professionalism of state legislatures. The index was constructed from three characteristics of state legislatures and Congress: 1. Compensation (salary and living expenses, in constant dollars); 2. Days in session; 3. Expenditures for services and operations (minus legislator compensation) per legislator (in constant dollars). These data were from 1993-1994 and were the most recent continuous professionalism data available.

State health department structural variables were collected from Ford, et al.'s (2003) previous work. Researchers evaluated a variety of documents from state health departments and rated them based on variables of interest that were translated into numerical scores. There were 21 total variables evaluated. While their study utilized cluster analysis to reduce the variables, the raw scores were used in this study in order to evaluate their association with preparedness score. A total of 41 states (not including Delaware, Illinois, Maine, Massachusetts, Michigan, South Dakota, Tennessee, Utah, West Virginia) were included in the analysis based on Ford et al.'s ability to contact the cabinet-level leader that had public health in her or his agency.

In order to evaluate state health department structure's association with preparedness, Ford et al.'s (2003) variables were used (Table 3). The variables assessed were meant to capture key structural factors as state health agencies have an extensive scope of activities and no single variable can measure their success. While the raw data were not available in Ford et al.'s (2003) publication, the lead author was contacted and raw scores were furnished for all evaluated states. Scores were sent in an Excel spreadsheet which was merged with the Excel spreadsheet of state pandemic plan scores and then imported into SPSS 16.5 for analysis.

Table 3. Health Department Structure Variable Definitions (Adapted from Ford, et al., 2003)

Variable Label	Definition
Dynamism	Instability in technology, client wishes, and competition.
Heterogeneity	Differences in services provided and resulting differences needed in competitive tactics.
Munificence	Steady funding, regulatory discretion, adequate workforce, sufficient materials, and favorable demographic trends.
Scanning	Amount of tracking and number of agency members involved in scanning the environment in terms of consumer and administrative issues.
Delegation of operating authority	Amount of authority for day-to-day operational decisions transferred from top managers to managers below.
Centralization of strategy-making power	Distribution of power to make long-term strategic decisions.
Resource availability	Amount of labor, materials, capital, facilities, and other resources within the agency.
Management tenure	Average number of years top managers have held their positions.
Controls	Number and scope of systems to measure performance trends.
Internal Communication	Ease and fidelity with which all kinds of information flows throughout the agency.
Agency differentiation	Degree of differences in goals, administration, behavior, operations, and management style between units or departments in the agency.
Professionalization	Percentage of staff with professional qualifications.
Hierarchy	Number of levels or organizational hierarchy.
Span	Average span of control for base of hierarchy.
Innovation	Amount of innovation used in terms of number and novelty of new services/products.
Adaptiveness/proactiveness	Amount of response by the agency to external environmental conditions.
Integration of decisions	Degree to which actions in one unit of the agency complement or support those in other units.
Conscious strategic analysis	Amount of time and thought devoted to real or perceive problems and ways to deal with the problems.
Multiplexity	Range of factors considered by top managers when making strategic decisions.
Futurity of decision	Time frame used by the agency in strategic planning.
Precedents	Degree to which the agency rethinks its strategies and the way in which it will attain its strategies.

Data Management:

All state plans were scored manually, and data were entered into an Excel spreadsheet. Data sheet scores were compared to inputted scores after entry to account for any entry errors. All manual data sheets have been retained to ensure back-up for the electronic files. Secondary coding was also conducted in this manner. All state plans were collected in March 2008 and kept electronically and in print form.

All data were collected and entered into Excel, cleaned and checked for accuracy and then merged into an SPSS version 16.5 database. Outliers were assessed via visual inspection of distributions and checked for accuracy. Ten state plans were coded and scored by a colleague to evaluate inter-coder reliability. Scores were then compared using a one-sample paired t-test and a type I error rate of 0.10. The level of alpha was determined on the basis of the small sample size and the consequential nature of a Type I error. A power analysis indicated that with a 10% type I error rate, there would be 90% power to detect a minimum difference of 15 points in the mean of ten total scores using a one-sample paired t-test. In order to confirm the findings of the t-test, the Kappa Statistic (Sim & Wright, 2005) was used to evaluate intra-class correlation.

Data Analysis

Descriptive statistics for the dependent variables are provided in Chapter 2; independent variables in Chapter 3 for all variables noted in Table 2; and Chapter 4 for variables in Table 3. Means, medians, standard deviations, and ranges are presented for continuous data; frequencies for dichotomous data.

Multicollinearity refers to excessive correlation of the predictor variables. When correlation is excessive as defined by r above .7, standard errors of the parameter estimates become large, making it difficult or impossible to assess the relative importance of the predictor variables (Tabachnick & Fidell, 2007). Multicollinearity is less important where the research purpose is sheer prediction since the predicted values of the dependent remain stable, but multicollinearity is a severe problem when the research purpose includes causal modeling. The primary interest of this study was to identify predictors of overall score, but close attention was paid to multicollinearity and independent variables were removed according to the theoretical models and the variables' explanatory value.

Political Theory Evaluations

All independent variables were either continuous or dichotomous. Continuous independent variables making up the political theory models were all normally distributed and parametric statistics were used in all analyses. Binary predictors including governor party in power, state senate party in power and congressional party in power were coded as indicator variables prior to analysis (Field, 2005; Myers, Gamst & Guarina, 2006). Differences in continuous dependent measures by dichotomous variables were evaluated using two sample t-tests. Levene's test for equality of variances was used with a significance threshold of .01 to account for multiplicity. Right skewed data was transformed logarithmically.

After multicollinearity was evaluated, Pearson Correlations were used to compare each of the dependent variables (10 domains and total score) and each of the independent variables. Multivariate associations are generally superior to univariate correlations because they better capture the full network of relationships among predictors and criteria (Stevens, 2002; Tabachnick & Fidell, 2007). Therefore, data were analyzed using a series of multiple regression analyses (MRA). For the regression analyses, the dependent variable was pandemic plan preparedness as evaluated using the composite (total score) from the CDC Checklist as well as each of the domain scores (Centers for Disease Control and Prevention, 2006c).

The first group of MRA models evaluated the association between *organizational capacity* and pandemic plan preparedness via total preparedness score and each domain score. The second group of MRA models evaluated the association between *overhead political control* and pandemic plan preparedness. The third group of MRA models evaluated the association between *task environment* and pandemic plan preparedness. In addition to testing the overall significance and predictive utility of the MRA models (as evaluated by the Adjusted R^2 statistic), each

analysis addressed which of its individual predictor's best estimated pandemic plan inclusion of federal recommendations. Two steps were used to evaluate unique contributions: (1) the MRA was used to determine whether each of its predictors made a statistically-significant unique contribution (Pedhazer, 1997), and (2) the analysis evaluated the relative magnitudes and direction of the unique contributions by comparing squared semi-partial coefficients among the statistically significant predictors (Darlington, 1990; Keith, 2006). Chapter 3 offers an in-depth explanation about the analysis for each of the independent variables and their correlations both with each other and the outcome variables.

Health Department Structure Analysis

When assessing state health department structure, there were 21 total variables that made up Ford et al.'s (2003) three constructs of environmental, structural, and strategy-making variables. While Ford et al.'s study utilized cluster analysis to reduce the variables, the raw scores were utilized in this study in order to evaluate their association with preparedness score. Ford et al.'s data were not normally distributed and non-parametric statistics were used to evaluate all data. To address multicollinearity, Spearman's Correlation Coefficient was used and variables correlated above 0.7 were removed. The following 15 variables remained in the analyses: dynamism, heterogeneity, delegation, centralization, resource, tenure, communication, differentiation, professionalization, hierarchy, span, innovation, integration, analysis, precedents (see Table 3 for definitions).

A total of 41 states (excluding DE, IL, ME, MA, MI, SD, TN, UT, and WV) were included in the analysis based on Ford et al.'s (2003) criteria for inclusion. Data were initially analyzed via Spearman correlations between each of the independent variables and preparedness score. Additionally, to evaluate the predictive power of the independent variables, multiple regression

analyses (MRA) were employed using the composite (total score) from the CDC Checklist as well as each of the ten domains evaluated by the preparedness measurement tool. Each of the regression analyses were plotted and visually inspected to ensure residuals were normally distributed.

Study Limitations

There were a number of limitations to this study that are important to keep in mind. The current study evaluated a cross-section of publicly available current state plans (as of March 2008). The plans were from varying years (2004-2007) which introduces a variety of challenges not only for comparing the plans themselves, but also for evaluating the factors that may influence those plans. Publicly available plans were analyzed because they have been posted for the public whom the plans are meant to protect; however, more up to date plans may exist, but are not available for public viewing. Without access to such documents, analysis must be conducted with the data that are available. Additional revisions since the collection date were not included in the analysis in order to compare state plans at a single point in time. Therefore, there are only 50 state plans to analyze which limits power to detect differences and effect. North Dakota's plan was not a complete plan, but rather a summary which could have resulted in lower scores in that state's analysis and comparison with other states. Coding state plans with a three point scale also introduces coding bias as there may be differences in coders' perceptions about descriptions of items. This evaluation also assumed that intervals between the three points were equal; however, this is only an assumption and was not tested for accuracy. Additionally, analyzing written plans may exclude planning activities such as drills and trainings that are not included in the written plans. Future research should include primary data analysis utilizing interviews and/or surveys to assess if written preparedness does in fact correlate with actual preparedness activities. However,

primary data analysis also introduces a variety of biases in responses as responders may respond to questions based on their desire to receive a high score, rather than report accurate information. Initially collecting secondary data excludes such bias and can offer a comparison for primary data.

The measurement tool was additive and did not weight specific areas of preparedness because there is no evidence that one specific area of preparedness is more important than others; however, it is possible that certain areas of the checklist may have greater impact than others. An evidence base currently does not exist to support weighing particular areas more than others, and any weighting would have been arbitrary. The lack of weighting was addressed by comparing percentages of total score to make comparisons across domains, but there are inherent challenges and limitations when comparing domains that have varying numbers of factors.

Another limitation of this study is the political factors chosen for prediction of the outcome variable. The factors were chosen based on previous studies as well as theory, but because states vary widely, some of the factors have built-in biases. For example, Pennsylvania has one of the most rural populations in the country along with two major metropolitan areas. Including an overall population density measure can overlook these variations. However, the measures utilized were chosen because they offer an easily comparable snapshot of different states.

Many of the independent variables were collected for varying years which introduces limitations in interpreting the findings as causality can be minimally interpreted. Every attempt was made to collect data for the year prior to plan creation; however, some of this data was not available. The reported results should not be considered causal inferences, but rather offer associations between variables. Additionally, the measure used for professionalism score (King, 2000) included some inherent limitations as the measure was from 1993-1994. While there may

have been some changes in professionalism score since this time, this measure was one of the few continuous measures of professionalism available in the literature as most measures of professionalism are rankings (Mooney, 1994; Squire, 2007) which would have meant this variable could not have been included in the regression analyses.

In the final analyses, independent variables were chosen based on Ford et al.'s (2003) work which utilized a variety of variables in order to reduce them to key cluster areas. Here, the factors were evaluated individually, rather than reduce them, making for a large number of independent variables with a small sample size which may have skewed the results. Additionally, not all states were included in Ford et al.'s analysis, and only a sample of states could be evaluated.

The assessment conducted in this study focused on public health structure, and there is little known regarding the link between specific preparedness structures with the ability to execute effective response procedures and impact population health (Lurie; Nelson, et al., 2007). However, because of the limited number of pandemics that occur, measuring the link between preparedness plans and response activity is problematic until the event occurs. Therefore, measuring written plan preparedness has offered an idea of level of preparedness based on standard recommendations prior to an event.

Dissertation Overview

The remainder of this dissertation will include three chapters consisting of manuscripts that present study findings and a conclusion. The second chapter addresses research question one and focuses on the surveillance results of the 50 state written pandemic plans inclusion of federal recommendations analysis. The manuscript offers an evaluation of what recommendations were included most across the country, and what areas remain for improvement.

The third and fourth chapters address research question two by evaluating factors that influence pandemic plan inclusion of federal recommendations. The third chapter discusses the comparison of three political models as explanations for pandemic plan inclusion of federal recommendations. Each of the models is evaluated individually as well as compared to each other. Potential explanations for preparedness are discussed based on the findings.

The fourth chapter focuses on the impact of state health department structure on state pandemic plans. The evaluation of health department structure was an extension of the second manuscript that showed that the political theories evaluated did not offer clear explanations for preparedness. The analyses conducted in the third manuscript offered better explanatory power for pandemic plan inclusion of federal recommendations. Recommendations for health departments to help improve pandemic preparedness are presented as well.

The conclusion offers key findings from the research overall as well as areas for future research. The research conducted in this project offers a unique perspective on pandemic influenza planning and adds to the evidence base for pandemic preparedness. The measurement tool developed here offers a clearly defined, replicable way to measure preparedness and addresses many of the gaps of previous research. The findings also offer explanations for preparedness that can be used to make improvements in pandemic planning.

CHAPTER 2

DO STATE WRITTEN PANDEMIC PLANS INCLUDE FEDERAL RECOMMENDATIONS? A NATIONAL STUDY

Abstract

The U.S. government has worked to empower states to respond to a pandemic, but there has been minimal evaluation to determine the success of such efforts. The purpose of this study was to examine states' preparedness for a pandemic as documented by states' written pandemic plans. The study was a cross-sectional comparative analysis of 50 states' pandemic influenza plans as of March 2008. The CDC's State and Local Pandemic Influenza Planning Checklist was turned into a matrix with each of 85 recommendations making up 10 overarching domains coded as "no mention" = 1, "brief mention but no description or action item" = 2, or "description or action of the item" = 3. Domain scores were constructed by taking each state's added factor scores and dividing them by the total possible score for that domain. Federal recommendations surrounding leadership, networking and surveillance have been well-integrated, but greater efforts are needed to develop partnerships with health care agencies and focus on antiviral preparedness and infection controls. The use of a clearly defined measurement tool can help states determine their level of preparedness and look to more prepared states for guidance, as well as lobby their legislators for additional resources.

Background

Historically, one of the greatest global health threats has been pandemic influenza. Pandemics have occurred three or four times in each century (United States Department of Health and Human Services, n.d.) and have killed millions of people worldwide, largely due to a lack of interventions to prevent the spread of disease. Based on the timing of previous outbreaks, another

pandemic is looming. Since its discovery in the early 21st Century, Avian Influenza (H5N1) has been considered the most likely type of influenza to become a pandemic. The H5N1strain is of particular concern to human health because of its documented ability to pass directly from birds to humans. Once transmitted to humans, the H5N1 strain has caused severe disease with very high morbidity and mortality (World Health Organization, 2005).

Pandemics are global disease occurrences associated with rapid world-wide spread, health care system overload, inadequate medical supplies, and economic and social disruption. Over 779 thousand Americans and 52.7 million people world-wide died from pandemics in 1918, 1957, and 1968 combined (United States Department of Health and Human Services, n.d.). Researchers have modeled the potential impact of a future outbreak, predicting 89 to 207 thousand deaths; 314 to 734 thousand hospitalizations; 18 to 42 million outpatient visits; and 20 to 47 million additional illnesses in the U.S. (Meltzer, et al., 1999). The Congressional Budget Office (2005) estimates that 30% of all workers would become ill and 2.5% would die. With 30% of workers missing an average of three weeks of work, the result would be a decrease in the U.S. gross domestic product of 5%.

Responding to an Influenza Pandemic

There are ongoing efforts by agencies at the international, federal, and state levels to improve pandemic influenza planning and preparedness, including efforts by the World Health Organization (WHO), World Bank, White House, General Accounting Office, state and local health departments and municipalities (World Health Organization Writing Group, 2006). Guided by the WHO's plan, the U.S. has committed resources to prepare federal, state, and local authorities for a pandemic situation by providing funding, opportunities for networking and interaction, and recommendations about what should be included in pandemic plans (Centers for

Disease Control and Prevention, 2006c; United States Department of Health and Human Services, 2007, n.d.).

While planning is important at the international and federal levels, the initial response to an influenza outbreak will occur at the state and local levels. States are in a unique position to gauge the emergency management needs of their political subdivisions, assess their own resources and those of the federal government, and facilitate the acquisition and application of these resources. State governments also give direct guidance and assistance to local jurisdictions in program development and channel federal guidance and assistance to communities (Perry & Lindell, 2003; Waugh, 1994). For example, federal agencies will filter financial aid through state health departments and emergency management agencies that will then disperse it to local governments and agencies. In a major emergency, the state's role is to ensure a coordinated response through the combined efforts of local, state, and federal agencies and private sector organizations (Perry & Lindell, 2003). Additionally, states have the capability to detect novel influenza strains in their state public health laboratories (Witt-Kushner, Astles, Ridderhof, Martin, Wilcke, et al., 2002) and implement containment measures (Gostin, et al., 2002). Unlike other disasters such as floods or hurricanes, communicable disease threats are managed by state health departments in coordination with the Centers for Disease Control and Prevention (CDC) and traditional emergency responders (United States Department of Health and Human Services, 2007).

Measuring Pandemic Preparedness

There have been a variety of studies that aim to measure state pandemic preparedness. Holmberg et al. (Holmberg, et al., 2006) reviewed 49 state pandemic influenza response plans to assess if and to what extent plans addressed vaccination, surveillance and detection, and community containment activities (Holmberg, et al., 2006), and found that while states tend to focus on

vaccination strategies, surveillance, and detection, there is wide heterogeneity in state plan containment measures.

In 2007, the Congressional Research Service (CRS) assessed state pandemic planning activities evaluating 66 factors in eight overarching areas including: leadership and coordination, surveillance and laboratory activities, vaccine management, antiviral drug management, other disease control activities, communications activities, health care services, and other essential services. Each state's plan was coded with a dichotomous yes/no measure of whether the factor was included (Lister & Stockdale, 2007). The measures used in the evaluation have not been published, but the findings showed that many states addressed core public health functions such as surveillance or vaccine management, but few plans addressed leadership and coordination, or the continuity of non-health services (Lister & Stockdale, 2007).

The National Governor's Association (National Governors Association, 2008) completed an extensive assessment of pandemic preparedness activities in all fifty states focusing on healthcare, commerce, education, and public safety via workshop notes and observations. The authors concluded that states are not fully prepared for a pandemic, but the nation is more prepared than it was before the federal government offered guidelines and resources to support planning activities.

Most recently, the CDC conducted a review of state preparedness planning activities (Centers for Disease Control and Prevention, 2008). The CDC's report outlines progress and gaps for the country overall as well as state specific information. The report focused on disease detection and investigation, public health laboratories, and emergency response. Findings showed that public health department strengths include increased detection and investigation of diseases through improvements in the public health workforce and data collection and reporting systems.

Each of these evaluations offers important information about state preparedness; however, overall there are some consistent flaws that have not been addressed. Previous studies all used varying definitions for preparedness, many of which were not clearly explained. Additionally, the methodologies used in each of the studies varied extensively from evaluating the state plan (Holmberg, et al., 2006; Lister & Stockdale, 2007) to conducting interviews with Governors (National Governors Association, 2008), and plan creators (Centers for Disease Control and Prevention, 2008; Levi, et al., 2008b). Both of these issues make longitudinal comparisons of preparedness problematic and reduce the effectiveness of preparedness research by not establishing consistent measures.

The threat of a pandemic has led to an expectation by elected officials, policymakers, and the public that states are prepared (Lurie, et al., 2006). Investments in preparedness have led to developments in public health agencies including working with new partners, experiencing changes in the workforce, utilizing new technologies, integrating preparedness with other public health functions, changing leadership, and increasing accountability (Lurie, et al., 2006). However, previous research, even with limitations, shows that gaps still remain. States that are under-prepared need guidance to improve upon the gaps, but without clearly defined measures, priorities for improvement are unclear. Recently, the Institute of Medicine (IOM) (Institute of Medicine, 2008) concluded that the future of public health preparedness requires criteria and metrics that enable public health systems to achieve continuous improvement and to demonstrate the value of society's investment.

Current Study

The current study focused on written plans because they are the initial step in preparedness activities and can offer evidence of states' consideration of federal recommendations. Written plans document the response activities and protocols generated by the planning process and practiced via trainings and exercises (Perry & Lindell, 2003). The current study addresses limitations of previous preparedness evaluations and offers two new advantages. First, clear definitions of preparedness were used based on the expertise and experience of infectious disease and public health experts. The use of clear, defined measures will allow this tool to be replicated over time and by various researchers, rather than redefining preparedness with each evaluation. Additionally, the tool utilizes a three point scale which captures nuances in plans ignored by dichotomous yes/no measurements, this allows for reporting of greater variation in plans and clarifying recommendations for improvement.

Since a pandemic has not occurred recently, an evidence base for all of the factors that should be included in pandemic planning has not been established; however, there is some consensus based on past experience of infectious disease outbreaks regarding the minimum factors that must be in place to respond effectively to a communicable disease threat (Centers for Disease Control and Prevention, 2006c). While states may implement their plans differently based on their populations, geography, and risk, states that do not meet the minimum recommendations will be less prepared to respond to a pandemic. There are some issues that are consistent in preparedness for any emergency (Perry & Lindell, 2003), but pandemics are unique because they last longer than most emergencies and require community mitigation strategies such as social distancing, isolation, and quarantine (United States Department of Health and Human Services, 2007).

The CDC created the State and Local Pandemic Influenza Planning Checklist (2006c) that outlines ten domains that should be addressed in state and local pandemic preparedness planning (see Table 1, pg. 20). These overarching domains focus on the key considerations for pandemic preparedness. Under each domain are specific *minimum* recommendations to ensure states have at least begun to consider all of the factors included in a pandemic response.

The purpose of this study was to evaluate states' level of pandemic preparedness, as measured by the inclusion of CDC recommendations in their written pandemic plans. The significance of this study lies in its ability to construct a baseline of information regarding state written plan comprehensiveness, and therefore a concrete step towards revising and improving plans. Additionally, the tool developed and presented here uses clear definitions and is easily replicable, allowing for longitudinal measurement of preparedness across states.

Methods

Constructing the Checklist

Based on the CDC's State and Local Pandemic Influenza Planning Checklist (2006c) (Appendix A), I developed a state pandemic plan assessment tool to evaluate the extent to which states' most recent written pandemic flu plans (as of March 2008) addressed minimum federal recommendations for state preparedness planning. The CDC's Checklist was turned into a matrix that included 85 factors comprising the ten domains described in Table 1 (pg. 20). (A list of all 85 factors is in Appendix B). The factors were taken from the CDC Checklist to ensure that each recommendation had its own score. For example, under vaccines, one of the CDC recommendations is "address the needs of vulnerable and hard-to-reach populations in the operation plan." The needs of the vulnerable became one factor, and the needs of the hard-to-reach became another in the measurement tool.

Written plans for the 50 United States were collected; 49 states' complete pandemic plans were publicly available on the web site www.pandemicflu.gov or the Council of State and Territorial Epidemiologists web site (http://www.cste.org/). North Dakota was contacted for its complete plan; however, the state preferred that the 2006 publicly available plan summary, available on the Health Department's web site, be used.

The plans were read and coded. Each recommendation had an interval measure of no mention (1), brief mention but no description or action item associated with the factor (2), or in-depth description of the item (3). For example, if a plan mentioned that risk communication was important, but did not explain assessment of communication needs, it received a score of 2; if the plan explained coordination with public partners, it received a score of 3 for that individual factor. By including a three point scale, more information was gleaned about the planning process and comprehensiveness of the plans compared to previous studies which included only dichotomous measures (Lister & Stockdale, 2007). It was assumed in the initial evaluation that the distance between each interval was equal. Future studies can evaluate the distance between scores more deeply or utilize the measures as categorical, rather than interval data to test this assumption.

Ten state plans were coded and scored by a colleague to evaluate inter-coder reliability. Scores from both coders were then compared using a one-sample paired t-test and a type I error rate of 0.10. The level of alpha was determined on the basis of the small sample size and the consequential nature of a Type I error. A power analysis indicated that with a 10% type I error rate, I would have 90% power to detect a minimum difference of 15 points out of 255 in the mean of ten total scores using a one-sample paired t-test. In order to confirm the findings of the

t-test, the Kappa Statistic (Sim & Wright, 2005) was used to evaluate intra-class correlation (α=.96).

Each state's domain scores were calculated by adding the scores for each factor within the domain. For example, the leadership and networking domain had 18 factors and a total possible score of 54. Each 1, 2, and 3 was added together to calculate a domain "raw score." In order to gain an understanding of average scores (percentage scores) in each domain, the domain "raw scores" were divided by the total possible score for each particular domain. In order to create a "total preparedness score" for each state, the unweighted scores of each domain were added together and divided by the total possible score (255). Previous measures have not applied weighting to their evaluations of multiple preparedness indicators (Centers for Disease Control and Prevention, 2008; Holmberg, et al., 2006; Lister & Stockdale, 2007), and it is not clear that any of the domain areas evaluated here is more important than others. Raw total "preparedness scores" and raw domain scores were the dependent variables in all of the evaluations; however, for descriptive purposes all states were compared via domain and overall average scores (Chapter 2). Future studies, particularly those conducted after such an event, could weigh domains based on their importance in practice. Overall trends and descriptive data by domain are reported below.

Data Analysis

All data were collected and entered into Excel, cleaned and checked for accuracy and then merged into an SPSS version 16.5 database. Outliers were assessed via visual inspection of distributions and checked for accuracy. Descriptive statistics for all domains were analyzed and are reported below. In order to utilize correlation statistics to compare domain scores, all domain

scores were plotted and visually inspected for normal distribution. Domain scores were compared using bivariate Pearson Correlations.

Results

The date of the state plans ranged from 2004-2007. The average number of pages was 108.3 pages, ranging from 406 pages (NY) to 11 pages (ND and WV); number of pages was correlated with preparedness score ($r=0.66$, $p<.01$). States with higher scores focused on explaining the factors in greater depth. Total scores ranged from 100 (WV) to 205 (MA) out of a possible 255 (Figure 4). Surveillance (WY and MD), communications (NY), and workforce support and psychosocial considerations (MD) were the only domains for which any state reached the maximum score possible (Table 3). (State specific data are noted in Appendix C; frequencies of scores for each factor are noted in Appendix D)

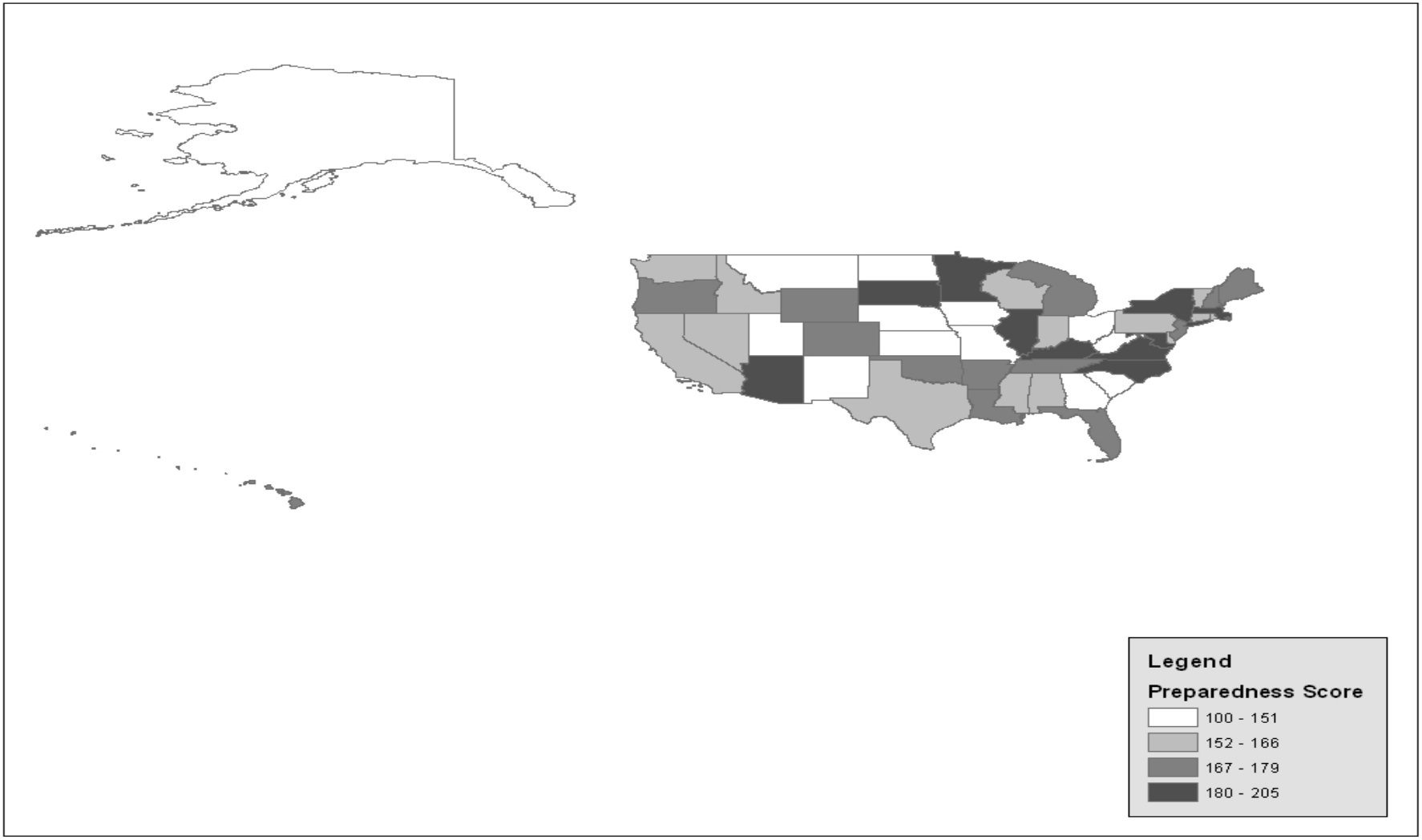

Figure 4. State Total Preparedness Scores by Quartiles

Table 4. Variation Measures and Average Scores by Pandemic Preparedness Domain

Domain Scores	Average	Mode	Min.	Max.	Range
Leadership/Networking (18 factors)	71%	72%	41%	91%	50%
Surveillance (5 factors)	75%	73%	33%	100%	67%
PH/Clinical Labs (4 factors)	60%	42%	33%	92%	58%
HC/PH Partners (14 factors)	53%	52%	33%	76%	43%
Infection Control (4 factors)	57%	50%	33%	92%	58%
Vaccines (13 factors)	62%	64%	33%	90%	56%
Antiviral (5 factors)	59%	53%	40%	80%	40%
Community Disease Control (10 factors)	67%	77%	33%	97%	63%
Communications (8 factors)	66%	67%	38%	100%	63%
Psychosocial (4 factors)	60%	58%	33%	100%	67%
Total Score (85 factors)	63%	60%	39%	80%	41%

Leadership and Networking

Leadership and networking is a key area of preparedness as states will need to work with other agencies and jurisdictions to ensure planning for all hazards (Waugh, 1994). The high score in this area differed from previous research that showed that leadership and coordination was a weakness in most states (Lister & Stockdale, 2007). West Virginia had the lowest score in this domain and did not reach a score of "3" in any of the factors. North Carolina had the highest score for leadership and networking and received a score of "3" for almost every factor. Twenty nine had scores above the mean (71%) for this domain.

Areas of strength in this domain (Appendix D) included establishing a pandemic preparedness committee, defining the responsibilities of the state, local, and federal government,

having a communications plan, defining who has authority for executing the plan, and maintaining an incident command system. There are also clear areas for improvement including: formalizing agreements with neighboring jurisdictions, maintaining a demographic profile of the community, creating a task force to support health care institutions, and ensuring clear identification of law enforcement personnel. Many states mentioned timelines, compliance with the National Incident Management System, integrating plans across jurisdictional boundaries, maintaining psychosocial support services, having a process for resource request, and ensuring the plan is scalable; however, the high numbers of "2"s in these areas leave room for improved explanation.

Surveillance

In addition to coordination between agencies, bioterrorism, emergency preparedness, and epidemiology are also important functions of state health departments (Beitsch, et al., 2006). All of these functions depend on strong surveillance systems to be successful. While surveillance was one of the highest scoring areas overall in this study, there were variations between states. Georgia received the lowest scores for this domain with a "1" for each factor. Three states, (AZ, MD, WY), received the highest score possible. Twenty-two states scored above mean (75%) for this domain.

Strengths in this domain (Appendix D) included ensuring year round surveillance for seasonal influenza and sharing data from local systems. Areas for improvement and increased description in state plans included having the capacity to rapidly identify novel strains of influenza and ensuring the ability to share data from federal systems. States were very weak in tracking information daily during a pandemic.

Public Health and Clinical Labs

State lab capacity for detecting novel strains of influenza can reduce the time between detection and treatment of influenza. In 1992, the Institute of Medicine published a report on the threat of microbes on the health of the United States (Lederberg, Shope & Oaks, 1992) and noted the importance of increasing coordination between public health and clinical health care to improve surveillance for and detection of emerging diseases. Five states (ME, MS, IN, NE, and UT) received the lowest scores for this domain. Two states (TN and WY) had the highest scores. Twenty-three states scored above the mean (60%) for this domain. The greatest gap in this area was surveillance for influenza among laboratory personnel. This area is of particular concern because lab personnel will be depended upon to test and detect novel influenza strains before and during a pandemic (Witt-Kushner, et al., 2002).

Public health and clinical labs had some clear weaknesses (Appendix D) including surveillance for influenza among laboratory personnel, a lab surge capacity plan, and informing clinicians about safe specimen collection. Many states did, however, at least mention the need to assess laboratory diagnostic proficiency.

Healthcare and Public Health Partners

Healthcare providers are essential in the detection of initial cases of novel or pandemic influenza in a community. Early identification and isolation of cases may help slow the spread of influenza (United States Department of Health and Human Services, 2005). Health care providers will be depended upon to find early signs of a novel influenza strain and must be included in the planning process (Lederberg, et al., 1992). Health care and public health partners was one of the weakest areas nation-wide. Nebraska had the lowest score, while Massachusetts had the highest score. Twenty-five states had scores above the mean (53%) for this domain. Public health

preparedness depends in large part on private clinicians who are trained to recognize emergency situations and report suspicions to public health officials (Salinsky, 2002). Until these complementary fields are better able to coordinate their activities, there remains considerable threat of delayed detection and a less effective response.

The health care and public health partners domain had some clear weaknesses (Appendix D) in the following factors: test the operational plan for the health care sector, test mortuary provisions, define a medical staffing emergency, exercise the plan to obtain credentials for volunteer health care personnel, and test the plan for dealing with exposed patients and health care personnel. Defining how the written plan will be exercised and tested was a consistent weakness in this and other domains. There were no factors in this domain where states received a majority of "3"s making this a key area for additional focus in state planning.

Infection Control and Clinical Guidelines

Individual clinicians and health care institutions face significant challenges in: 1) quickly identifying and triaging cases, 2) containing the spread of infection, 3) beginning an efficient and comprehensive workup, 4) initiating antiviral and other supportive therapy, and 5) anticipating clinical complications (United States Department of Health and Human Services, 2005). Similar to the healthcare domain, infection control and clinical guidelines are often neglected in preparedness evaluations (Centers for Disease Control and Prevention, 2008) as these areas are often considered outside the realm of public health. Two states, WV and AL, had the lowest scores because they did not mention any of the factors in their plans. One state, WY, had the highest score for this domain. Twenty-six states had scores above the mean (57%) for this domain. Gaps included having access to EPI-X, a CDC web-based communication system where

epidemiologists can exchange information about health issues, and testing a plan to update providers as a pandemic unfolds.

States did well in two areas of the infection control and clinical guidelines domain (Appendix D): utilizing the Health Alert Network and creating messages to education healthcare providers; however, most states did not mention testing a plan to update health care providers as a pandemic unfolds or giving local health authorities access to EPI-X, a web-based epidemiology information system.

Vaccines and Antivirals

Vaccines are widely considered to be the most effective means to reducing morbidity and mortality during a pandemic (Oshitani, 2006); however, the impact of vaccines remains to be demonstrated. One state, ND, received the lowest possible score for this domain, while Massachusetts received the highest score; however, North Dakota's plan summary was evaluated which may have impacted the state's score in this area. Gaps in this area included addressing the cost of vaccines, having agreements with personnel and organizations for distribution, and addressing the needs of the vulnerable and hard-to-reach. Twenty-seven states had scores above the mean (62%) for this domain. States were strong (Appendix D) in having a plan for vaccine distribution, use, and monitoring, vaccine tracking, and defining priority populations; however, weaknesses remained in exercising the operation plan for obtaining vaccines, addressing the needs of vulnerable and hard to reach populations, and addressing the cost of vaccines.

Antivirals are expected to be effective against pandemic influenza and will be the only available pharmaceutical intervention until enough vaccines are produced (Oshitani, 2006). Amantadine and rimantadine have been shown to be therapeutically effective if initiated within 1-2 days of symptom onset in young, previously healthy adults; however, it has not been

established whether treatment is effective in severe influenza or preventing influenza in high-risk populations (Hayden, 1997).

Trust for America's Health's 2008 evaluation of state preparedness (Levi, et al., 2008b) noted that all 50 states have adequate plans to distribute emergency vaccines, antidotes, and medical supplies from the Strategic National Stockpile (SNS); however, we found that Georgia, Massachusetts and Nebraska had the lowest scores and made no mention of the SNS in their written pandemic plans. It is possible that these states have separate SNS plans that are not part of the pandemic plan, but having plans that are scattered may be problematic as responders try to find and coordinate different plans during an emergency. States without such a plan may be unable to distribute medical resources to their citizens during an emergency. Other studies have also found inconsistent descriptions for antiviral attainment via SNS or private companies in many states (Lister & Stockdale, 2007). Here, five states (CT, ND, NE, SC, and UT) had the lowest scores for antivirals. Three states (SD, IL, and OK) had the highest scores. Twenty-five states had scores above the mean (59%) for the antivirals domain. Gaps in this domain (Appendix D) included addressing the cost of antivirals and testing an operational plan for procurement.

Community Disease Control and Prevention

Community containment strategies, including isolation, quarantine, snow days, and increased personal and medical institution hygiene are fundamental public health measures used to control the spread of communicable diseases (Centers for Disease Control and Prevention, 2004). These strategies all have the primary goal of preventing person-to-person spread of disease by separating those with disease or at increased risk for developing disease from those at lower risk. This domain was addressed by all states, although some states only mentioned that such

strategies would be used, but did not describe when or how they would be implemented. Two states, (KS and TX), received the lowest scores for this domain, while three states (MD, MN and VA), had the highest scores. Twenty-three states' scores were above mean scores (67%) in this domain. The largest gaps (Appendix D) in this domain were in identifying local, state and federal authority for implementing containment plans. The lack of clear delineation of responsibilities can lead to an uncoordinated and disorganized response.

Communications

Communication during an emergency is one of the most important elements in responding quickly and appropriately to a threat (United States Department of Health and Human Services, 2002). Communication includes coordinating with public and private partners, training spokespersons, and implementing community resources (Centers for Disease Control and Prevention, 2006c). Consistent with other studies (Lister & Stockdale, 2007) communication is a strength for some states and continues to be a challenge for others. Three states, (DE, SC and VA), had the lowest scores while one state (NY) had the highest score for this domain. Twenty-two states had scores above the mean (66%) for the communications domain. Gaps in this area (Appendix D) included assessing readiness to meet communication needs and training public health communications staff in risk communication.

Workforce Support: Psychosocial Considerations and Information Needs

In addition to addressing the needs of the public through risk communication, the needs of responders must be considered in a pandemic response (Deane, et al.). This area had some of the lowest scores of all the domains. Eight states (GA, KS, OH, NB, ND, NV, SC and UT), had the lowest score for this domain as they did not address any of the factors. Two states, (NC and MD), received the highest scores. Twenty states had scores above the mean (60%) for this

domain. Gaps for this area (Appendix D) included developing workforce resilience programs, and public health messages. The findings in this area were consistent with previous studies where psychosocial support services for responders were found to be lacking in most states (Lister & Stockdale, 2007).

Domain Comparisons

All of the domains were positively correlated with each other. There are interesting implications of the relationships among domains. Leadership and networking score was significantly and positively associated with communications score as was healthcare and public health partners score (Table 5). States seem to recognize the need for increased communication capacity, particularly among emergency managers, public health officials, and healthcare providers to whom the public will look for answers. Leadership and networking, healthcare and public health partners, and communications scores may be associated with psychosocial consideration scores which supports the claim that effective leaders are likely to ensure that responders and healthcare providers as well as the public have access to both physical and mental health services and messages (Centers for Disease Control and Prevention, n.d.).

Table 5. Bivariate Pearson Correlations Between Domains											
		Leadership and Networking	Surveillance	Labs	HC/PH Partners	Infection Control	Vaccines	Antivirals	Disease Control	Communication	Psychosocial
Leadership and Networking	Pearson Correlation	1									
	Sig. (2-tailed)										
Surveillance	Pearson Correlation	**.302***	1								
	Sig. (2-tailed)	**.033**									
Labs	Pearson Correlation	.211	**.368****	1							
	Sig. (2-tailed)	.142	**.009**								
HC/PH Partners	Pearson Correlation	**.521****	.276	**.441****	1						
	Sig. (2-tailed)	**.000**	.053	**.001**							
Infection Control	Pearson Correlation	**.341***	.230	.207	.241	1					
	Sig. (2-tailed)	**.015**	.108	.149	.092						
Vaccines	Pearson Correlation	.271	.202	**.385****	**.394****	.172	1				
	Sig. (2-tailed)	.057	.160	**.006**	**.005**	.232					
Antivirals	Pearson Correlation	**.422****	.165	**.300***	**.497****	.222	**.570****	1			
	Sig. (2-tailed)	**.002**	.252	**.034**	**.000**	.121	**.000**				
Disease Control	Pearson Correlation	**.390****	**.490****	**.406****	**.560****	.192	**.301***	**.317***	1		
	Sig. (2-tailed)	**.005**	**.000**	**.003**	**.000**	.182	**.033**	**.025**			
Communications	Pearson Correlation	**.586****	.223	**.305***	**.536****	**.291***	**.398****	**.388****	**.460****	1	
	Sig. (2-tailed)	**.000**	.120	**.031**	**.000**	**.041**	**.004**	**.005**	**.001**		.000
Psychosocial	Pearson Correlation	**.519****	.231	**.443****	**.587****	.194	**.323***	**.414****	**.578****	**.516****	1
	Sig. (2-tailed)	**.000**	.107	**.001**	**.000**	.177	**.022**	**.003**	**.000**	**.000**	

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

In addition to being associated with leadership and networking score, health care and public health partners was positively and significantly correlated with community disease control and prevention score. This finding was particularly interesting because healthcare and public health partners was a weakness nation-wide; however, given the importance of health care, public health, and the implementation of community interventions during an emergency, it is necessary that all three areas be as robust as possible.

Not surprisingly, vaccine scores were correlated with antiviral scores. Many of the same strategies must be in place for the attainment and distribution of both resources. During a pandemic, it is possible that both vaccines and antivirals will be used either for treatment or prophylaxis, and clear plans for attaining these resources are necessary for effective responses.

Surveillance, infection control and clinical guidelines, and public health and clinical lab scores were not correlated above .5 with any other domain. This finding is interesting as these are all areas that are traditional public health responsibilities (Beitsch, et al., 2006), and it would be expected that states with strengths in one of these areas would have them in others.

Discussion

Previous evaluations of state preparedness have found weaknesses in a variety of areas including containment measures (Holmberg, et al., 2006), leadership and coordination (Lister & Stockdale, 2007), lab capacity (Centers for Disease Control and Prevention, 2008), legal framework (Centers for Disease Control and Prevention, 2008), laboratory workforce (Centers for Disease Control and Prevention, 2008), communication systems (Centers for Disease Control and Prevention, 2008; Lister & Stockdale, 2007), and trainings (Lister & Stockdale, 2007). Overall, strengths included leadership and networking and surveillance; however, while some states have included greater descriptions of recommendations than others, the findings here are consistent

with previous evaluations of pandemic preparedness (Centers for Disease Control and Prevention, 2008; Holmberg, et al., 2006; Lister & Stockdale, 2007) and show that there is room for improvement in preparedness plans among all states in all domains. It is important to note that low scores in some domains may not mean that factors are missing altogether; however, it is important for states to address the gaps in their plans whether it means adding an area that is completely lacking, or improving the description of items already in the plans. While previous evaluations have used varying measures and data sources, they all show clear variation between states in preparedness measures. The challenge in comparing such evaluations is that there is no standard measurement tool to compare across studies. This evaluation offers the advantage that some states may be able to improve their plans by expanding the plan itself through greater description of their processes as states with more in-depth plans had higher scores. The evaluation tool used here can be easily replicated over time, while prior evaluations have used less definitive measures making longitudinal studies more challenging.

Limitations

Although this analysis offers states a snapshot of their pandemic plan integration of federal recommendations, there were a variety of limitations in this evaluation. This study looked at the cross-section of publicly available current state plans (as of March 2008). Publicly available plans were analyzed because they have been posted for citizens whom the plans are meant to protect; however, more up to date plans may exist, but are not available for public viewing. Additionally, many plans were from different years making comparison across plans challenging. Many states view more recent pandemic plans as secure documents, and are unwilling to share these documents with the public, although it is unclear why this is the case. Additional revisions since plan collection were not included in the analysis in order to compare

state plans at a single point in time. Another limitation was the use of North Dakota's plan summary which could have impacted the results of that state's analysis and comparison with other states.

Evaluating plans with a three point scale assumed that there were equal intervals between each of the codes. This assumption was not tested, and it is not clear if states may have to do more work to address some factors compared to others. Analyzing written plans may also exclude planning activities such as drills and trainings that are not included in the written plans. Such omissions may mean that data about planning activities is missing from this analysis. Future research should include primary data analysis utilizing interviews and/or surveys to assess if written preparedness does in fact correlate with actual preparedness activities. Additionally, calculating preparedness scores by dividing mean scores by total possible score has an impact on the explanatory value of the analysis conducted in this study. Some of the domains had outliers, and mean scores can only offer a general overview of plan comprehensiveness. The purpose of this study was to gain a general sense of pandemic planning across the country. Individual state data is available (Appendix C) and may offer a more concrete evaluation of specific state strengths and weaknesses.

The measurement tool was additive and did not weight specific areas of preparedness because there is no evidence that one specific area of preparedness is more important than others; however, it is possible that certain areas of the checklist may have greater impact than others. An evidence base currently does not exist to support weighing particular areas more than others, and any weighting would have been arbitrary. The lack of weighting was addressed by comparing percentages of total score to make comparisons across domains, but there are inherent challenges

and limitations when comparing domains that have varying numbers of factors which may be addressed in future research.

Conclusion

The study findings showed that the greatest gaps among all states in written planning exist in the domains of health care and public health partners, infection control and clinical guidelines, antivirals, and workforce support and psychosocial considerations. This is particularly troublesome as health care responders (Lederberg, et al., 1992), infection control (United States Department of Health and Human Services, 2005), and antivirals (Hayden, 1997) are likely to be the most immediate and effective ways to mitigate a pandemic prior to vaccine production. States should find ways to focus on these areas and include health care partners in planning to ensure a pandemic can be addressed in its early stages. Other studies (Centers for Disease Control and Prevention, 2008; Holmberg, et al., 2006; Lister & Stockdale, 2007) have also found weaknesses in these areas, and all agree that these are key areas to improve upon.

Written plans are the initial step to preparing a community for an emergency. If written plans are not comprehensive, responses will be more likely to have gaps. States can utilize these findings in order to lobby state legislatures for additional resources to address their weaknesses, refocus health departments on pandemic planning, and include new partners such as universities to improve planning. States can also use this instrument, based on best-practices and expertise-based guidelines, to continuously evaluate and update their plans to respond to a pandemic emergency.

The current study was the first of its kind to offer a defined measure of state written pandemic plan inclusion of federal recommendations. While progress has been made since the first case of Avian Influenza was detected (Centers for Disease Control and Prevention, 2008; Holmberg, et

al., 2006), states have not included many federal recommendations in their plans. The study conducted here offers states a unique opportunity to improve upon their weaknesses, compare their plans with other states, work with other states that have more comprehensive plans to learn from their experience, and measure their progress over time. In addition, the tool developed for this study can be used to further explore preparedness within different levels of government and expand the evidence-base related to pandemic preparedness.

CHAPTER 3

POLITICAL FACTORS ASSOCIATED WITH STATE PANDEMIC FLU PLANS

Abstract

State health departments have been charged with creating pandemic plans. Research on bureaucratic behavior has focused on regulation and distribution activities, but state pandemic plan creation does not fit these categories. Federal and state governments have invested resources in pandemic planning and published recommendations for such planning; however, it is unclear what influences inclusion of those recommendations in written plans. This study compared three explanations for bureaucratic behavior to evaluate what factors are associated with pandemic plan inclusion of federal recommendations. Findings showed that state pandemic plan creation is a bureaucratic anomaly, and recommendations for future research to better understand this behavior are offered.

Background

Pandemic influenza is a virulent flu of global dimensions which easily spreads from person to person, and little if any immunity is present (Gingerich, 2006). Pandemics have occurred multiple times in each century (United States Department of Health and Human Services, n.d.). Based on the timing of previous outbreaks, another pandemic is imminent and will be associated with rapid world-wide spread, health care system overload, inadequate medical supplies, and economic and social disruption (Meltzer, et al., 1999). Over 779 thousand Americans and 52.7 million people world-wide died from pandemics in 1918, 1957, and 1968 (United States Department of Health and Human Services, n.d.), and a future pandemic could be similarly devastating.

While planning for a pandemic is important at the international and federal levels, in the United States the initial response to an influenza outbreak will occur at the state and local levels. Millions of dollars have been granted to states since the late 1990's for public health infrastructure and preparedness (Salinsky, 2002). The 50 states, the District of Columbia, three local jurisdictions (New York City, Chicago and Los Angeles County), five U.S. Territories, and three Freely Associated States of the Pacific shared $325 million in cooperative agreement emergency supplemental funds to help create and fill gaps in their pandemic influenza preparedness plans and to test these plans. In August 2007, a supplemental $75M was announced as well (United States Department of Health and Human Services, n.d.). States must be prepared to take action during a pandemic influenza outbreak because they will be called upon first to implement containment and response measures. States will also be responsible for coordinating requests and resources between federal and local governments.

The federal government has offered states guidance on pandemic planning including a strategic framework for planning (United States Department of Health and Human Services, n.d.), outlines of community strategies (United States Department of Health and Human Services, 2007), and a document focused on what to expect during the next flu pandemic (United States Department of Health and Human Services, n.d.). The Department of Health and Human Services and other federal agencies have also held pandemic planning summits with public health, emergency management and response leaders in each state (National Governors Association, 2008).

The state has emergency responsibilities that local governments do not share. State emergency management agencies and health departments are in a unique position to gage the emergency management needs of a state's political subdivisions, assess their own resources and those of the

federal government, and facilitate the acquisition and application of these resources. State governments also give direct guidance and assistance to local jurisdictions in program development and channel federal guidance and assistance to communities. In a major emergency, the state ensures a coordinated response through the combined efforts of local, state, and federal agencies and private sector organizations (McLoughlin, 1985).

Most states have a single agency that takes "lead" responsibility for emergency preparedness and response activities. The nature of such agencies and their lines of authority vary, but they all fall into one of five types of organizations. Authority in all cases is legislated to the governor, but is operated in: 1) the executive office, or delegated 2) to a civilian department, 3) to the adjutant general, 4) to the state police, or 5) to a council which oversees departmental activities (McLoughlin, 1985). Because communicable disease threats do not affect communities in the same way as other disasters such as floods, bombings, tornadoes, and the like, the lead agency differs in these events. Communicable disease threats are managed by state health departments in coordination with the Centers for Disease Control and Prevention (CDC) and typical emergency responders, such as emergency management agencies (United States Department of Health and Human Services, 2007).

During a pandemic, the states' role will be to coordinate both the local and federal responses. States must have specific policies and procedures in place prior to the onset of illness in order to mitigate the impact of a pandemic. In the event of large-scale illness, written plans should allow non-traditional responders the ability to react appropriately with minimal experience or training. The federal government has offered little supervision on the nature and content of pandemic plans; however, it has offered a variety of recommendations, the most comprehensive of which

are the CDC's State and Local Planning Checklist (Centers for Disease Control and Prevention, 2006c).

In the first phase of this study, the CDC checklist was used to evaluate written state pandemic flu plans in order to assess their level of inclusion of federal recommendations (see Chapter 2). The findings showed that no state included all federal recommendations in its pandemic plan, and there was great disparity in the number and extent to which states did include federal recommendations. Currently, it is unclear why there is such variance in state pandemic plans. The purpose of this phase of the study was to evaluate what political and economic factors are associated with state written pandemic plan integration of federal recommendations as measured by three overarching political theories for bureaucratic behavior.

Bureaucratic Behavior

Bureaucracies regulate private industry, individual behavior, and government activities as well as offer a variety of goods and services (Meier & Bhote, 2007). While the responsibilities of bureaucratic agencies are clearly defined, understanding bureaucratic behavior and policymaking continues to challenge political scientists and public policy researchers. Bureaucracies are responsible for four policy areas including regulatory policy, redistributive policy, distributive policy, and constituent policy (Meier & Bhote, 2007). These areas define what bureaucratic agencies do, and help researchers evaluate bureaucratic behavior based on the role of the agency in question.

Regulatory policies consist of government restrictions to keep individual or institutional conduct from transcending acceptable bounds (Meier & Bhote, 2007). Redistributive policy taxes one group of people in order to provide benefits for another group, while distributive policy uses general tax revenue to provide benefits directly to individuals, rather than redistribute

financial resources. Constituent policy is made up of policies that do not fit among the other three policy areas and includes national security and government service bureaus such as the Office of Personnel Management (Meier & Bhote, 2007). Each of these agencies has different roles and responsibilities, but the predictors of their behavior are often similar. Studies have linked bureaucratic behavior to human behavior theory (Schmidt, 2000), pressure from different branches of government (Wood & Waterman, 1994), internal hierarchical relationships (Downs, 1967), interest groups (Moe, 1990), and political support (Rourke, 1984). Each of these players has been shown to have a clear influence on bureaucratic decision-making by implementing relevant legislation, applying political pressure, and appropriating funding; however, prior evaluations of bureaucratic policy making has focused on traditional bureaucratic activities including enforcing regulations and distributing goods and services, while the activity of interest here is internal pandemic plan creation.

State health departments are bureaucratic agencies with responsibilities that include policy making, priority setting, data collection and analysis, financing, and oversight of local public health activities (Wall, 1998). However, health departments have additional responsibilities that fall outside the bounds of "traditional" bureaucratic behavior. State health department pandemic plan creation is an example of a situation where activity is under bureaucratic control, but is a solely internal process where neither resources nor services are distributed outside of the agency. State health departments are creating plans that are speculative and may be activated at a later date. Upon plan implementation, the policies may be regulatory if movement is restricted, redistributive if funds are shifted to support health care costs for the uninsured, or distributive via mass vaccination or antiviral distribution, but the plan alone is not a policy outcome or typical

bureaucratic behavior. Little research has been conducted to evaluate this type of bureaucratic behavior.

In this study, the state health department bureaucratic behavior of developing a statewide pandemic influenza preparedness and response plan was evaluated to see if this type of behavior could be explained by existing theories of bureaucratic behavior. Based on theory and previous research (Keiser, 1999; Meier & Bhote, 2007; Whitford, 2007), it was hypothesized that the ability of such agencies to create comprehensive plans was contingent upon a variety of factors which would fall into three overarching theoretical models for policy outcomes.

Organizational Capacity

The organizational capacity framework suggests that an agency's organizational attributes including its rules, regulations, and reward mechanisms determine its decisions (Downs, 1967; Thompson, et al., 2003). There are three overarching areas that make up this framework: an organization's beliefs and culture; managerial constraints and workforce composition; and its leadership's turf, strategies and innovation influence the outcomes of an organization (Wilson, 1989). Specific factors that influence organizational capacity include organizational resources, rules and tools, and incentives and control mechanisms (Whitford, 2007; Wilson, 1989).

Organizational capacity focuses strictly on the internal structure and processes of a bureaucratic agency. Although bureaucracies are at the mercy of external political and environmental influences, it is the internal capacity that will impact policy making, implementation, and regulation (Whitford, 2007). Bureaucratic agencies that are charged with particular tasks, but lack the capacity to implement them will be less successful (Whitford, 2007). Organizational capacity was measured via the resources and staff in health departments and emergency management agencies.

Hypothesis 1: Organizational capacity, as measured by state resources for emergency planning, will be the best predictor for the inclusion of federal recommendations in states' pandemic influenza plans.

Overhead Political Control

The overhead political control model suggests that the preferences and influences of external political forces determine the decisions of an agency. Here, bureaucratic preferences are centered on the hierarchical role of political actors including legislators, governors, and the President (Ringquist, 1995; Wood & Waterman, 1994). The mechanisms for control include the legislature (Brudney & Henert, 1987; Huber & Shipan, 2000; McCubbins & Schwartz, 1984; Weingast & Moran, 1983; West, 1995) and the executive branch as they create policies that bureaucratic agencies enforce (Moe, 1989) including business (Noll, 1971), environmental (Joskow, 1974), occupational health (Scholz & Wei, 1986), and trade (Weingast & Moran, 1983) regulations. The focus of this theory is that individual political actors and bodies define what bureaucratic agencies will do based on their desires manifested in the laws they create and enforce (Moe, 1990). Agencies may be encouraged to support executive actions via increased funding and legislative support of beneficial legislation, but they can also be forced to comply via mandates and executive orders (Moe, 1990).

State health departments have been charged with pandemic plan creation, and, because of the constraints of federalism, the federal government stopped short of mandating what should be in state pandemic plans. Instead, the federal government offered funding to states for pandemic planning and encouraged the utilization of federal recommendations in the creation of their plans; however, that does not necessarily make health departments immune to political pressure both from other government agencies and the public.

Hypothesis 2: Overhead political control, as measured by state political variables, will be the best predictor for the inclusion of federal recommendations in states' pandemic influenza plans.

Task Environment

The theory of task environment argues that the problems and situational imperatives facing an agency determine the choices it makes (Joskow, 1974; Noll, 1985; Scholz & Wei, 1986). Bureaucrats respond to social problems and to circumstances external to their organizations (Scholz & Wood, 1999; Wilson, 1989). The task environment model claims that structural attributes of the environment frame bureaucrats' understanding of what they should be doing, how they should do it, and whether their actions have an impact (Whitford, 2007). Essentially, bureaucrats obtain information about their tasks via broad concepts of their states' economic and environmental circumstances (Brehm & Hamilton, 1996; Salemi, 1995). Task environment addresses how factors in the general environment impact bureaucratic agencies' effectiveness.

Hypothesis 3: Task environment, as measured by the situational imperatives facing an agency, will be the best predictor for the inclusion of federal recommendations in states' pandemic plans.

Recently, Whitford (2007) tested these three explanations of bureaucratic preferences to evaluate which theory offered the best explanation for the bureaucratic implementation of policies governing the remediation of hazardous waste at the state level in the United States. The comparisons showed that bureaucratic preferences are best explained by the organizational capacity model rather than the political and task environment theories, at least for regulatory activities. Similarly, an empirical test using a data set from public education showed that bureaucratic values (organizational capacity) are far more influential in explaining bureaucratic outputs and outcomes than political factors (Meier & O'Toole, 2006).

In addition to Whitford's (2007) work comparing these three models, Keiser (Keiser, 1999) found that the variation in the implementation of the Social Security Disability program is a function of levels of need for benefits, the health of the economy, and state partisan politics. The findings suggest that professional norms (organizational capacity) play a large role in directing the ways that street-level bureaucrats use their discretion. The implementation of the Social Security program is not, however, apolitical. While the bureaucracy is professional, it is also responsive to local political concerns (overhead political control).

Similar to previous studies (Keiser, 1999; Whitford, 2007), it was expected that pandemic planning was a function of external factors including economics, demographics, and external political actors, because state health departments are bureaucratic agencies subject to the same constraints as other similar agencies. The implementation of pandemic plans is beyond the scope of this study, but it is believed that overhead political control would have an influence on plan implementation as the legislators in power would decide when and how the plan would be implemented. In this evaluation of plan creation, it was anticipated that the first hypothesis would be accepted and the other two rejected.

Methods

This was a cross-sectional study of the 50 United States' publicly available written pandemic plans as of March 2008. Forty-nine complete state pandemic plans were publicly available on the web site www.pandemicflu.gov or the Council of State and Territorial Epidemiologists web site (http://www.cste.org). North Dakota was contacted for its complete plan; however, the state preferred that the publicly available plan summary, available on its web site, be used.

Dependent Variable

Initially, the CDC (2006c) State and Local Pandemic Influenza Planning Checklist was turned into a matrix with 10 domains consisting of 85 factors measured. The 50 state plans were read and coded for each of the factors; each recommendation had a categorical measure of no mention (1), brief mention but no description or action item associated with the factor (2), or in-depth description of the item (3) (see Chapter 2). Each state's domain scores were calculated by adding the scores for each factor within the domain. For example, the leadership and networking domain included 18 factors with 3 possible integer scores (1, 2, and 3) resulting in a total possible domain score equal to 54. Each 1, 2, and 3 was added together to calculate a domain score. In order to create a "total preparedness score" for each state, the unweighted scores of each domain were added together. Both domain and total preparedness scores were plotted and were normally distributed upon visual inspection. Table 4 notes descriptive statistics for the dependent variables.

Independent Variables

To operationalize the theoretical models, a variety of measures were collected and evaluated for their individual and collective association with preparedness. (Variable measurements and data sources are noted in Table 2).

Organizational Capacity

For the purposes of this evaluation, organizational capacity focused primarily on the resources necessary for health departments to create a comprehensive written pandemic plan because organizational resources (staff, funding levels, and funding sources) constrain bureaucratic activities (Whitford, 2007). Specific constraints include the number of staff associated with a program, number of funding sources a program has and total funding for the program.

Managerial constraints are directly linked to funding levels as reduced funding limits the amount of planning that can be completed. Beliefs and culture, while more difficult to measure, are directly impacted by the resources an agency has to complete its work as reduced resources will require increased creativity and improvisation, similarly strategies and innovation are also impacted by resources as limited resources will minimize innovation. Pandemic planning is an internal organizational activity, and it was expected that the most important resources necessary for emergency planning included funding and staff levels because of the strong focus of these areas at both the federal and state levels in preparedness.

Variables to measure organizational capacity focused on three different areas of resources: emergency management resources, health resources, and staff resources. Although state health departments created their pandemic plans internally, they will depend upon other agencies including state emergency management in the implementation of their plans. The need for integration with other agencies required inclusion of external resources in evaluating plan creation (Nelson, 199.; Wasserman, et al., 2007). It was believed that states with fewer emergency management resources would have less extensive pandemic plans. Pandemics will require extensive health interventions making health resources necessary to ensure effective planning and response (United States Department of Health and Human Services, 2007). States that had increased health resources, as measured by health expenditures, were believed to have more extensive pandemic plans as they would be more likely to address all of the health issues involved in pandemic planning. The last area measured for organizational capacity was staff. Staff resources are necessary in both planning and response (Mays, McHugh, Shim, Perry, Lenaway, et al., 2006) and reduced staff levels and salaries at both emergency management agencies and health departments may decrease the extensiveness of pandemic plans.

Variables collected for the organizational capacity framework included emergency management funds per 1,000 people, federal aid for disaster relief per 1,000 people, federal aid to state emergency management planning and assistance per 1,000, and cooperative agreement funds per 1,000 people. Health expenditures variables included health expenditures per 1,000 people, and federal expenditures on department of health and human services grants per 1,000 people. Staff variables collected included emergency management agency full-time staff per 1,000 people, health commissioner salary per 1,000 people, and federal expenditures on department of health and human services salaries and wages per 1,000 people. All variables for this model were collected via *The Book of the States* (Council of State Governments, 2007).

Overhead Political Control

In the current study, the variables that made up overhead political control focused primarily on governor and legislative influences on state planning (Huber & Shipan, 2000; Moe, 1990). Democratic governors with low salaries and smaller staffs were thought to be would be more likely to include federal recommendations in state plans because they would have less time to influence planning. The lack of involvement by the state executive branch in planning may make health departments more dependent upon federal recommendations for plan creation. Similar to governor involvement, it was hypothesized that a highly professional legislature defined by King's professionalism scale (King, 2000) with a Republican majority would have less extensive pandemic plans because of resistance to public health funding from more conservative legislators. Civic engagement was also considered because bureaucracies in states that have higher levels of community involvement in politics may have to answer more directly and regularly to the public (Moe, 1990).

Variables that made up governor influence (see Table 2) included: governor involvement in state emergency management agency director and health commissioner appointments, partisanship of governor, number of governor staff and governor's salary. In order to evaluate legislative impact on pandemic plans, the size of Democrats compared to Republicans in the state House of Representatives and Senate were measured and state legislative professionalism score was collected. The impact of voter turnout for the 2000 presidential election by state was collected to capture civic engagement's impact on pandemic planning. All variables were collected from *The Book of States* (Council of State Governments, 2007) except for legislative professionalism score (King, 2000).

Task Environment

Public health agencies in general are impacted by environmental and economic conditions. Public health departments depend on external resources funded by tax dollars, and they act as a safety net for many who do not have access to other health resources. As tax revenue decreases in economic downturns, the public has an increased need for public health services (Holahan & Garrett, 2009). Public health agencies are at the mercy of external environmental factors including funding for public health programs (Levi, et al., 2008a), population characteristics (Holahan & Garrett, 2009), and revenue streams (Holahan & Garrett, 2009; Levi, et al., 2008a) for their subsistence and ability to fulfill their responsibilities.

Economic and environmental conditions were also suspected to impact pandemic planning. Population density (Cohen, 1999; United States Department of Health and Human Services, 2007), number of uninsured (Holahan & Garrett, 2009), and income level (Cohen, 1999) all affect the spread of communicable diseases. States that had higher levels of population density,

increased uninsured, and more low-income populations were expected to have more extensive pandemic plans as they would have higher risk populations.

Variables used to test task environment (see Table 2) included population density, urban population, Medicaid/Medicare expenditures per capita, percent uninsured, median household income, total state revenue per 1,000 people, and per capita income. Variables for this model were collected from Kaiser Family Foundation (The Henry J. Kaiser Family Foundation, n.d.) and the US Census Bureau (United States Census Bureau, n.d.-a, n.d.-c).

All data were collected for the year before the most recent publicly available plan was created, unless otherwise noted in Table 6. Financial data that was not available for the year before the plan was created were adjusted for inflation using the Bureau of Labor Statistics inflation calculator to the year before plan creation. Table 6 shows descriptive statistics for all independent variables. All data were plotted and visually inspected for normal distribution. Right skewed data was transformed logarithmically, and log data were used for all evaluations. Variables transformed included: health expenditures per 1,000, emergency management funds per 1,000, emergency management agency full time employees for 1,000, cooperative agreement funds per 1,000, disaster aid expenditures per 1,000, federal aid to state emergency management planning expenditures per 1,000, health commissioner salary per 1,000, federal expenditures on department of health and human services salaries and wages per 1,000, federal expenditures on department of health and human services grants per 1,000, governor salary, and population density. All other independent variables were normally distributed as were dependent variables.

Table 6. Independent Variable Descriptive Statistics by Political Model

Variable	Mean	Median	Standard Deviation	Range
Organizational Capacity				
Health Expenditures Per 1000+	$166,846	$151,470	$83,377	$331,800
Emergency Management Fund Expenditures Per 1000+	$1,440	$630	$2,409	$15,730
EMA FTE Per 1000+	0.19	0.16	0.15	0.80
2003 Cooperative Agreement Funds Per 1000+	$4,428	$3,500	$2,281	$9,840
2003 Disaster Aid Expenditures Per 1000+	$7,683,100	$3,234,300	$19,268,600	$13,400,000
2003 Federal Aid to State Emergency Management Planning Expenditures Per 1000+	$2,534	$890	$8,179	$58,030
Commissioner Salary Per 1000+	$51	$30	$52	$205
2003 Federal Expenditures on Salaries and Wages Per 1000+	$28	$3	$84	$472
Federal Expenditures on DHHS Grants per 1000+	$912	$864	$292	$1,689
Overhead Political Control				
Governor Involved in EMA Appointment	Frequencies: No=21; Yes = 29			
Governor Involved in Health Commissioner Appointment	Frequencies: No=9; Yes = 41			
Voter Turnout *	55%	55%	10%	42%
Governor Salary+	$116,928	$117,000	$25,530	$109,000
Governor Staff	59	39	60	302
Governor Party	Democrats = 22; Republicans = 28			
House Democrats **	50%	51%	19%	1.02%
Senate Democrats **	59%	46%	17%	70%
Professionalism	0.26	0.25	0.15	0.84
Task Environment				
Population Density+	182	88	250	1133
% Urban	68%	69%	15%	60%
Medicaid Expenditures Per Capita	$851	$791	$253	$1,339
Medicare Expenditures Per Capita	$986	$981	$188	$891
Median Income	$44,151	$43,294	$6,134	$23,345
Revenue Per 1000	$5,886	$5,450	$1,962	$12,290
% uninsured	14%	14%	4%	16%
2003 Per Capita Income	$35,384	$33,966	$5,239	$22,748

* North Dakota and Wisconsin excluded; North Dakota has no registration and Wisconsin has same day registration
** Nebraska was excluded; the state has a unicameral legislature
+ log transformation was used

Data Analysis

All independent variables were either continuous or dichotomous. Binary predictors including governor party in power, state senate party in power and congressional party in power were coded as indicator variables prior to analysis {Myers, 2006 #169}; Field, 2005 #118}. Differences in continuous dependent measures by dichotomous variables were evaluated using two sample t-tests. Levene's test for equality of variances was used with a significance threshold of .01 to account for multiplicity.

Chronbach's Alpha was used to evaluate if the independent variables making up the three political theory models captured overarching theoretical models. Organizational capacity and overhead political control both had alphas of .002, while the task environment model had an alpha of .574. Future studies should consider gathering additional independent variables which may be more indicative of the theoretical models evaluated in this study.

Factor analysis was used to evaluate the validity of the proposed three constructs within the theoretical framework conceptualization. Factor analysis should have confirmed three factors defined by the theories used to evaluate state preparedness scores. Exploratory factor analysis with promax (oblique) rotation analysis was conducted which suggested 5 factors. Few of the variables had strong loadings on any of the factors and the five that were identified by the analysis were not indicative of the theoretical models, nor were they logically connected by any other common identifier. There were too few variables to pull out specific factors, and independent variables were not collapsed into clusters or factors and were individually evaluated.

Initially, two-tailed Pearson Correlations were utilized to evaluate the relationship of continuous independent variables with each other as well as their relationship with total score and domain scores. To address multicollinearity, independent variables correlated with each

other above 0.7 were removed. Variables thought to offer more explanatory value based on the theoretical models remained in the analyses.

Data were analyzed using a series of multiple regression analyses (MRA). The dependent variables for the analyses were both the composite (total score) from the CDC Checklist as well as the domain scores, and the independent variables were defined by the theoretical models. In addition to testing the overall significance and predictive utility of the MRA models (as evaluated by the adjusted R^2 statistic), each analysis addressed which of its individual predictors best estimated pandemic plan inclusion of federal recommendations by evaluating the unique contribution of each predictor. Multiple-regression analyses were used to determine whether each of the predictors made a statistically-significant unique contribution (Pedhazer, 1997).

Results

Bivariate Pearson Correlations between total preparedness score and the independent variables showed three significant relationships. Total preparedness score was significantly and positively associated with the number of governor staff (r=.351, p=.012), population density (r=.315, p=.026), and per capita income (r=.404, p=.004). Correlation results for each of the domain scores by theoretical model are noted in tables 7-9.

Table 7. Pearson Correlation Results for Organizational Capacity and Domain Scores

		Health Expenditures+	EMA Expenditures+	EMA FTE+	Disaster Aid+	Federal Aid+	Commissioner Salary+	DHHS Wages+	DHHS Grants+
Leadership and Networking	Pearson Correlation	.008	-.054	-.137	.149	-.156	-.102	-.094	-.077
	Sig. (2-tailed)	.958	.707	.344	.305	.284	.481	.516	.594
Surveillance	Pearson Correlation	.115	-.042	-.042	.047	-.116	-.041	.162	**-.311***
	Sig. (2-tailed)	.425	.770	.770	.749	.428	.778	.261	**.028**
Labs	Pearson Correlation	.047	-.026	-.161	**.321***	-.148	**-.282***	-.048	.013
	Sig. (2-tailed)	.747	.856	.264	**.025**	.310	**.048**	.741	.931
HC/PH Partners	Pearson Correlation	.125	-.059	-.163	.139	-.123	-.264	.199	.144
	Sig. (2-tailed)	.388	.683	.257	.340	.399	.064	.166	.320
Infection Control	Pearson Correlation	-.195	-.019	-.031	.137	-.226	.047	-.152	-.073
	Sig. (2-tailed)	.174	.893	.833	.350	.119	.748	.291	.614
Vaccines	Pearson Correlation	.057	-.238	-.210	.180	-.244	**-.284***	-.166	.074
	Sig. (2-tailed)	.695	.097	.143	.215	.091	**.046**	.248	.608
Antivirals	Pearson Correlation	-.016	-.218	-.169	.102	-.054	-.148	-.048	-.021
	Sig. (2-tailed)	.914	.127	.240	.484	.713	.305	.739	.886
Community Disease Control	Pearson Correlation	**.322***	.046	-.025	.113	-.148	-.016	.091	.118
	Sig. (2-tailed)	**.023**	.749	.865	.440	.310	.913	.530	.414
Communications	Pearson Correlation	-.010	-.081	**-.312***	.220	-.160	**-.307***	-.070	.073
	Sig. (2-tailed)	.945	.575	**.027**	.129	.273	**.030**	.631	.615
Psychosocial Considerations	Pearson Correlation	-.006	-.070	-.192	.239	-.141	-.166	.136	.139
	Sig. (2-tailed)	.968	.631	.182	.098	.333	.249	.346	.334

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

+ Log transformation was used.

Table 8. Pearson Correlation Results for Overhead Political Control++ and Domain Scores

		Governor Salary	Governor Staff+	Senate Democrat	Professionalism
Leadership and Networking	Pearson Correlation	.231	.223	.197	.148
	Sig. (2-tailed)	.111	.120	.174	.305
Surveillance	Pearson Correlation	-.122	-.027	-.098	-.087
	Sig. (2-tailed)	.405	.852	.502	.548
Labs	Pearson Correlation	.258	**.334***	.120	.194
	Sig. (2-tailed)	.073	**.018**	.413	.177
HC/PH Partners	Pearson Correlation	.154	**.409****	**.345***	.227
	Sig. (2-tailed)	.291	**.003**	**.015**	.112
Infection Control	Pearson Correlation	.051	-.027	-.134	-.008
	Sig. (2-tailed)	.728	.852	.358	.957
Vaccine	Pearson Correlation	.153	**.430****	.186	**.282***
	Sig. (2-tailed)	.295	**.002**	.200	**.048**
Antiviral	Pearson Correlation	.173	**.336***	.111	.099
	Sig. (2-tailed)	.236	**.017**	.448	.492
Disease Control	Pearson Correlation	-.028	.095	.164	.081
	Sig. (2-tailed)	.847	.512	.260	.575
Communication	Pearson Correlation	.148	**.289***	.168	.271
	Sig. (2-tailed)	.310	**.042**	.250	.057
Psychosocial Considerations	Pearson Correlation	.176	**.309***	.253	.113
	Sig. (2-tailed)	.225	**.029**	.080	.435

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
+ Log transformation was used.
++Dichotomous variables were removed for correlation analyses.

Table 9. Pearson Correlation Results for Task Environment and Domain Scores

		Population Density+	% Urban	Medicaid Expenditures	Medicare Expenditures	Revenue per 1,000	% uninsured	Per Capita Income
Leadership and Networking	Pearson Correlation	**.319***	.254	-.161	.075	-.077	.020	**.501****
	Sig. (2-tailed)	**.024**	.075	.263	.604	.597	.889	**.000**
Surveillance	Pearson Correlation	.055	.184	**-.410****	-.143	-.200	-.157	.193
	Sig. (2-tailed)	.703	.202	**.003**	.322	.163	.276	.179
Labs	Pearson Correlation	.259	.213	-.183	.237	-.024	.022	.249
	Sig. (2-tailed)	.069	.138	.202	.097	.871	.879	.082
HC/PH Partners	Pearson Correlation	**.350***	**.326***	.065	.107	.014	-.019	**.391****
	Sig. (2-tailed)	**.013**	**.021**	.653	.460	.921	.895	**.005**
Infection Control	Pearson Correlation	-.092	.105	-.037	.018	.126	.069	.201
	Sig. (2-tailed)	.526	.469	.798	.903	.382	.635	.161
Vaccine	Pearson Correlation	.226	.207	.044	.089	.010	.116	.125
	Sig. (2-tailed)	.115	.149	.762	.537	.945	.423	.388
Antiviral	Pearson Correlation	.166	.065	.6	.117	-.103	.087	.040
	Sig. (2-tailed)	.248	.652	.804	.417	.478	.550	.783
Disease Control	Pearson Correlation	.127	-.026	.039	-.015	.056	-.120	.270
	Sig. (2-tailed)	.379	.856	.790	.918	.697	.405	.058
Communication	Pearson Correlation	.260	.226	-.104	.142	-.108	-.060	**.331***
	Sig. (2-tailed)	.068	.114	.474	.327	.454	.681	**.019**
Psychosocial Considerations	Pearson Correlation	**.328***	.021	.005	.141	-.139	.006	.269
	Sig. (2-tailed)	**.020**	.885	.973	.330	.337	.966	.059

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

+ Log transformation was used.

Based on the results of the Pearson Correlations, it appeared that governor staff, commissioner salary, population density, and per capita income were significantly and positively associated with pandemic preparedness scores. In order to evaluate the impact of the models, multiple regression analyses were conducted with total score and each of the individual domains as the dependent variable for each of the theoretical models.

The first set of MRA models evaluated how well *organizational capacity* affects pandemic plan preparedness (Table 10). The organizational capacity model offered a 3% fit for total preparedness score (Adjusted R^2=-0.032). None of the individual variables offered statistically significant explanatory power for the outcome variable. The organizational capacity model was also evaluated with each domain score. Out of the 10 analyses, only two variables were statistically significant in explaining any of the domains: higher DHHS grant funding was a predictor for higher surveillance score (p=.001), and higher disaster aid was a predictor for higher public health and clinical lab score (p=.042).

Table 10. Organizational Capacity Linear Regression Results with Total Preparedness Score

Organizational Capacity Variables*+	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
Health Expenditures per 1,000	8.649	7.742	.187	1.117	.271
Emergency Management Funds per 1,000 (2003)	-1.725	3.228	-.091	-.534	.596
EMA FTE per 1,000	-4.116	9.085	-.115	-.453	.653
Disaster Aid per 1,000 (2003)	3.752	2.868	.223	1.308	.198
Federal Aid to State Emergency Planning per 1,000 (2003)	-3.247	4.124	-.141	-.787	.436
Health Commissioner Salary per 1,000	-.620	5.620	-.027	-.110	.913
Federal Expenditures on DHHS salaries and wages per 1,000 (2003)	-.265	1.821	-.022	-.145	.885
Federal Expenditures on DHHS grants per 1,000 (2003)	-6.467	14.012	-.085	-.462	.647
R^2 = .140; Adjusted R^2=-.032					

* Cooperative agreement funds was significantly and positively correlated with EMA FTE (r=.733; p.<01) and Health Commissioner Salary (r=.932; p<01). Cooperative agreements funds were removed from all analyses.
+ Log transformation was used.

The second set of MRA models evaluated how well *overhead political control* predicts pandemic plan preparedness (Table 11). The model overall offered a 9% fit (Adjusted R^2=0.090) for total preparedness score. Percentage of registered voter turnout (p=0.038) was the only statistically significant contributor to preparedness score, but when entered by itself it was no longer significant (p=0.145). Governor staff came close to significance for total preparedness score (p=.068).

A number of variables in the overhead political control model offered positive and statistically significant explanations for domain scores: higher voter turnout was a predictor for higher surveillance score (p=.006), higher public health and clinical labs score (p=.002), and higher

health care and public health partners score (p=.032). Higher numbers of governor staff was a positive predictor for higher public health and clinical lab score (p=.009), higher health care and public health partners score (p=.034), higher vaccine score (p=.027), and higher antivirals score (p=.046). Governor involvement in EMA appointment was a significant predictor for higher health care and public health partner score (p=.003). Governor involvement in health commissioner appointment was a positive predictor for higher community disease control and prevention score (p=.008). Democratic governor was a positive predictor for higher public health and clinical labs score (p=.027).

Table 11. Overhead Political Control Linear Regression Results with Total Preparedness Score

Overhead Political Control Variables*	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Governor Involved in EMA Appointment	8.861	6.487	.210	1.366	.180
Governor Involved in Health Commissioner Appointment	3.393	8.321	.062	.408	.686
Registered Voter Turnout (2000)	.749	. 348	.353	2.151	**.038**
Governor Salary	-.0006	.000	-.078	-.379	.707
Governor Staff +	9.072	4.835	.337	1.877	.068
Governor Democrat	8.245	6.227	.199	1.324	.194
State Senate Democrats	4.878	19.586	.038	.249	.805
Professionalism Score	19.647	29.296	.143	.671	.507
R^2=.252; Adjusted R^2=.090					

*Percentage of House Democrats and Percentage of Senate Democrats were significantly correlated (r=.855; p<01). House Democrats was dropped from this model.
+ Log transformation was used.

The third set of MRA model evaluated how well *task environment* predicted pandemic plan preparedness (Table 12). While the model as a whole did not explain a large percentage of total preparedness score (Adjusted R^2=0.084), per capita income was the only variable that offered a statistically significant explanation for total preparedness score (p=.050) When that variable was

entered by itself into a regression with total preparedness score, it offered a p=0.004 significance level. Median household income, given its correlation with per capita income, was evaluated by itself and found to be significant as well (p=0.038). While population density was correlated with preparedness score, it was not significant in this model.

Higher per capita income offered predictive power for higher leadership and networking score (p=.001) as well as higher total preparedness score. Although this variable did not meet the .05 significance level, it was closely positively associated with higher infection control and clinical guidelines score (p=.086), higher community disease control and prevention score (p=.099), higher communications score (p=.104), and higher psychosocial considerations score (p=.063). Higher Medicaid expenditures was a significant predictor of higher surveillance score (p=.012) in this evaluation.

Table 12. Task Environment Model Linear Regression Results with Total Preparedness Score

Task Environment Variables*	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
Population Density+	3.758	3.991	.243	.942	.352
% Urban	-.172	.293	-.115	-.589	.559
Medicare Expenditures Per Capita	-.008	.023	-.065	-.336	.739
Medicaid Expenditures Per Capita	-.005	.015	-.061	-.350	.728
Revenue per 1,000	.000	.002	-.033	-.174	.862
% Uninsured	.897	.947	.150	.948	.349
Per Capita Income (2003)	.002	.001	.417	2.02	**.050**
R^2=.216; Adjusted R^2=.085					

*Median household was removed from the task environment model. Median household income and per capita income were highly correlated (r=0.887, p<0.000).
+ Log transformation was used.

All three models were considered with total preparedness score in a fourth MRA model (Table 13), but only governor involved in EMA appointment (p=.029) and governor staff (p=.034) were

significant, The fourth MRA model only accounted for 1.4% of the variance of preparedness score (Adjusted R^2= .014), and the significance of the two variables noted should be considered with caution.

Table 13. All Independent Variables Linear Regression Results with Total Preparedness Score

All Variables	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
Health Expenditures per 1,000+	20.458	11.592	.478	1.765	.092
Emergency Management Funds per 1,000 (2003)+	-1.916	3.498	-.109	-.548	.590
Disaster Aid per 1,000 (2003)+	1.823	4.093	.116	.445	.661
Federal Aid to State Emergency Planning per 1,000 (2003)+	-5.749	6.049	-.270	-.950	.353
Health Commissioner Salary per 1,000+	14.658	10.420	.676	1.407	.174
Federal Expenditures on DHHS salaries and wages per 1,000 (2003)+	-3.093	2.442	-.277	-1.266	.219
Federal Expenditures on DHHS grants per 1,000 (2003)+	-12.064	23.489	-.171	-.514	.613
Governor Involved in EMA Appointment	21.804	9.329	.519	2.337	**.029**
Governor Involved in Health Commissioner Appointment	5.933	10.413	.110	.570	.575
Registered Voter Turnout (2000)	.130	.541	.062	.240	.812
Governor Staff +	19.353	8.525	.711	2.270	**.034**
Governor Democrat	8.781	7.330	.212	1.198	.244
State Senate Democrats	5.883	37.888	.047	.155	.878
Professionalism Score	33.596	52.277	.246	.643	.527
Population Density+	-6.297	7.868	-.423	-.800	.433
% Urban	-.236	.390	-.169	-.607	.550
Medicare Expenditures Per Capita	-.023	.029	-.214	-.800	.433
Medicaid Expenditures Per Capita	-.012	.022	-.154	-.563	.580
Revenue per 1,000	-.006	.004	-.630	-1.488	.151
% Uninsured	-1.162	1.354	-.205	-.858	.401
Per Capita Income (2003)	.001	.001	.257	.880	.389
R^2=.529; Adjusted R^2=-.014					

+ Log transformation was used.

When beginning this study there were some variables which were expected to have more explanatory value than others. Health expenditures per 1,000, disaster aid per 1,000, federal aid to state emergency planning agencies per 1,000 people, democratic governor, democrat controlled house, % urban and population density were all entered into a multiple regression analysis together to evaluate if the variables thought to offer the most explanation for preparedness score would have an effect without the other variables in the models. However, none of the variables offered a statistically significant explanation for total preparedness score.

The findings show that none of the three theories was definitively associated with inclusion of federal recommendations in state pandemic influenza plans. However, some of the findings regarding the association between individual variables and preparedness are interesting. Additionally, the findings offer opportunities for additional research to better understand the factors at play in this type of bureaucratic behavior.

Discussion

The findings did not offer enough evidence to uphold any of the three proposed hypotheses However, the findings of this study present an initial evaluation of political impacts on bureaucratic plan creation. It is clear that unlike other bureaucratic behaviors (Keiser, 1999; Meier & O'Toole, 2006; Whitford, 2007) plan creation may be dependent upon factors other than those evaluated here. Beyond testing the theories, the study offers potential explanations for bureaucratic behavior that does not conform to the legislative process. Therefore, this discussion will address the findings related to individual factors as opposed to the full models.

The federal government has earmarked billions of dollars in pandemic planning (United States Department of Health and Human Services, n.d.), but this analysis suggests that funding may not be what drives states to create comprehensive preparedness plans. Of all the models,

organizational capacity offered the least explanation for preparedness score and none of the variables in that model were significant. Given the large focus on funding for preparedness, these findings are particularly interesting and troublesome. While financial resources may have been integral in getting a plan written at all, money does not seem to influence the level of preparedness. This finding may mean that the strategies the federal government has used to increase state preparedness may be ineffective, and that there are other factors that influence preparedness that are not understood at this point.

Unlike government resources, citizens' financial resources appeared to be a factor influencing plan creation. Citizen income had a stronger influence on the outcome than government income and resources suggesting that higher personal income may increase civic engagement (Ashenfelter & Kelley, 1975; Brooks & Brady, 1999). Voter turnout, a measure of civic engagement, did seem to have some explanatory power; however, in this analysis, voter turnout was not highly correlated with per capita income. Increased income may lead to increased tax base for states which can in turn increase resources for state health departments, but tax revenue is more complex than income alone (Feldstein, 1995). These variables may be proxies for other variables, such as interest group activity (Moe, 1990), that might have a stronger impact on bureaucratic behavior. Additional research should explore such avenues to better explain pandemic preparedness planning.

The influence of politicians as measured by the overhead political control model offered the best fit of any of the models; however, only the governor staff and voter turnout variables offered consistent significant explanatory value in this model when used to evaluate both the domains and total score. Political actors may have greater influence on plan creation than originally believed. Governors are designated with the authority to implement pandemic plans in most

states, and this authority may increase their oversight in plan creation. Governors with higher numbers of staff may have personnel dedicated to public health who can offer oversight of the planning process. Additionally, the legislature oversees state budgets and the recent increase in funding for pandemic preparedness may improve legislative oversight of the planning process. Future research can evaluate the impact of external political forces in planning through key-informant interviews with plan creators.

The task environment model also offered some fit for preparedness score, although per capita income was the only statistically significant variable in the model. External influences may impact pandemic planning in ways that were not captured by the variables evaluated here. Given the 2009 economic crisis, additional analysis could be conducted longitudinally to evaluate whether changing external economic and social factors impact pandemic planning.

This is the first time the three models presented here have been used to evaluate this type of bureaucratic behavior. Since plan creation is an anomaly, there may be other factors that influence this activity which were not captured in the theoretical models evaluated here. What is clear is that this type of bureaucratic behavior is different than many of the behaviors studied in the political science and public administration literature. Internal bureaucratic factors may offer better explanations for this type of behavior since pandemic planning is conducted primarily within health departments. Additional research is needed to further understand the factors that actually do impact pandemic planning and may include state health department structure (Duncan, et al., 2007; Ford, et al., 2003) or coordination with other agencies (Kettl, 2003).

Limitations

There were a variety of limitations to this study which may have impacted the results. Although this study focused on the universe of 50 states, that small number along with the large number of

independent variables collected compromised the sensitivity of the data analysis. While including the universe in the study does allow for clearer comparisons across states, it reduces the power of the analysis and the ability to clearly determine significance. If this study was replicated to assess state plans over time the results may look quite different as the sample size could be much larger.

Plans were from varying years as were independent variables making assessing the relationships between the two difficult to evaluate. The variations between scores of 1, 2, and 3 were also limited (see Appendix D) for some areas, particularly those with minimal factors for the domain. Additionally, North Dakota's plan summary was used rather than the entire plan document limiting the interpretability of that state's findings.

Another limitation of this study was the number of factors chosen for prediction of the outcome variable. The factors were chosen based on previous studies as well as the theoretical models, but because states vary widely, some of the factors had built-in biases. For example, Pennsylvania has a highly rural population in along with two major metropolitan areas, and including an overall population density measure can overlook these variations; however, such a measure can offer an easily comparable snapshot of different states. Many of the measures were also collected from different points in time, reducing the interpretation of causality. Additionally, because the universe was included only select variables could be assessed. Variables expected to offer the greatest explanation of the behavior in question were included in the analyses, but additional variables could be measured to evaluate their association with preparedness score.

Conclusion

Future studies should evaluate other potential factors that impact both written preparedness and preparedness activities. It is possible that other political, administrative, and/or network theories

may better explain this bureaucratic activity. Additionally, it is possible that while these models did not explain written plans, they may explain preparedness drills and exercises because those activities require greater integration between agencies. It is clear that additional research must be conducted in order to evaluate the resources and activities that increase preparedness at the state level. Research in this area continues to be a challenge as limited resources are allocated for evaluating the impact of investments in preparedness. The current study adds to the evidence base for pandemic preparedness policy and offers a means for objective accountability in pandemic planning.

This research shows that the focus on funding for preparedness may be ill conceived as it does not appear to actually have an impact on pandemic preparedness. Additional factors seem to influence state public health planning activities including civic engagement, and the size and expertise of the Governor's office. While these variables are difficult for health departments to address directly, they may offer state legislatures and executive branches a better idea of where to focus their energies when trying to improve preparedness. Governors may consider adding staff with expertise in preparedness or public health. Additionally, increased focused on civic engagement may allow people to more clearly voice their concerns and be heard by bureaucratic agencies. Both of these areas can be improved upon via relatively minor investments, and may yield high outcomes in the event of an emergency. Health departments should work with their state legislators and governors to increase the focus on preparedness both among government agencies, and the public at-large.

CHAPTER 4

STATE AGENCY STRUCTURE AND PANDEMIC PLANNING

Abstract

Pandemic influenza is an imminent threat. Research has shown that there are great disparities in state pandemic planning; however, little work has been done to assess how health department structure impacts pandemic preparedness. Here, the impact of state health department structure on state pandemic flu plan inclusion of federal recommendations was evaluated in order to understand the factors that influence pandemic preparedness. The study consisted of a cross-sectional analysis of 41 states and found that structural and strategy-making variables have the greatest impact on pandemic preparedness. Strong, multi-layered health department hierarchies, and the tenure of senior staff are negatively associated with preparedness while professionalization is positively associated with pandemic plan comprehensiveness. State health departments can increase their effectiveness in pandemic preparedness by reducing layers of bureaucracy and increasing training for staff.

Background

In 1988, the Institute of Medicine (IOM) commissioned the report, *The Future of Public Health* (Institute of Medicine, 1988) where it identified and made recommendations regarding state and local health departments' core functions of assessment, policy development, and assurance (Institute of Medicine, 1988). Recommendations included collecting and analyzing data about the health of communities, developing public health policies, and ensuring that necessary services were available to those in need.

Researchers and agencies have since offered additional guidance to public health agencies which expanded upon the IOM report (Centers for Disease Control and Prevention, 2000; Roper,

et al., 1992). Roper et al. (1992) noted that although progress had been made since the IOM report's release, the public health system still had to focus on five critical needs: increasing the knowledge base of public health workers, dynamic leadership from public health officials and agencies, access to data, disease prevention and health promotion plans, and funds for prevention programs. Almost ten years after Roper's (1992) report, the Centers for Disease Control and Prevention (CDC) updated the key goals and recommendations for public health's infrastructure including a skilled workforce, robust information and data systems, and effective health departments and laboratories (Centers for Disease Control and Prevention, 2000). There have been a variety of studies (Centers for Disease Control and Prevention, 1994; Scott, et al., 1990) evaluating the progress of state health departments since the 1988 IOM report was released, and while progress has occurred, gaps remain.

State health departments agreed with the IOM report regarding critical public health activities of assessment, policy development, and assurance of access to services (Scott, et al., 1990). State health departments have met some of the IOM goals including the establishment of separate departments of health from other bureaucratic agencies, agreed-upon public health duties, outreach, infrastructure, and scope of responsibilities. However, states have reported that the function of policy development is an area that is lacking (Scutchfield, et al., 1997b).

There have been core changes in the structure and functions of state public health systems over the past decade, from agencies that focus on population-oriented preventive activities to more clinical and individually focused activities (Wall, 1998) and emerging threats such as bioterrorism and disaster preparedness (Beitsch, et al., 2006). Understanding the impact of such changes is necessary to evaluate public health system performance (Beitsch, et al., 2006; Wall, 1998). Research has found that organizational characteristics impact success in health services

delivery organizations (Bazzoli, Shortell, N.L., Chan & Kralovec, 1997; Dubbs, Bazzoli, Shortell & Kralovec, 2001). However, there have been few recent studies that have focused on state public health system's structure and functions (Beitsch, et al., 2006) and their impact on performance. There is a growing body of public healthy systems literature which uses health services research methodologies to evaluate public health system performance (Dubbs, et al., 2001; Lenaway, et al., 2006; Mays, et al., 2006; Scutchfield, et al., 1997a; Wall, 1998).

Public health systems research has documented changes in state health agency structures and responsibilities (Beitsch, et al., 2006, Scutchfield, 1997 #258). Such changes have created new challenges for state health departments, particularly in the area of emergency preparedness and response (Salinsky, 2002). While public health agencies will be expected to respond during any emergency, (Salinsky, 2002) they will have to take the lead during a pandemic because of the unique nature of such an event focusing specifically on the health of communities (Association of State and Territorial Health Officials, 2007). Unlike other disasters such as floods or hurricanes, communicable disease threats are managed by state health departments in coordination with the (CDC) and traditional emergency responders (United States Department of Health and Human Services, n.d.).

Pandemic Influenza

Pandemic influenza is a virulent flu of global dimensions and outbreaks which easily spreads from person to person, and little if any immunity is present (Gingerich, 2006). World-wide disease outbreaks have occurred approximately 12 times in 400 years (Kuszewski & Brydak, 2000), and they have killed millions of people. Increased travel, global commerce, and the surfacing of novel viruses make pandemics a continuous threat to the morbidity and mortality of people around the globe. Based on the timing of previous pandemics, another pandemic is

imminent (Kuszewski & Brydak, 2000; Potter, 2001), and the international health community is preparing for a worst-case scenario (World Health Organization, 2006b).

In the United States, state public health agencies will be the initial responders to a pandemic influenza outbreak. While local responders are first "at the scene" of an emergency, they have limited resources to respond to a large-scale event. States are able to assess the needs of localities under their jurisdictions and bring federal resources to local agencies. In a major emergency, the state ensures a coordinated response through the combined efforts of local, state, and federal agencies and private sector organizations (McLoughlin, 1985). States that are more prepared to respond to such an emergency are more likely to reduce the impact of such an event on their populations (World Health Organization Writing Group, 2006).

State agency structure, including processes, staff, resources, hierarchy, innovation, and use of technology, has shifted over time with new recommendations, research, and lessons learned (Ford, et al., 2003). Many states now have a separate department of health rather than being under another state agency, agreed-upon public health duties, increased outreach, strengthened infrastructure, and defined scope of responsibilities. (Scutchfield, et al., 1997a). While progress has been made in general health department activities in almost all states, little work has been done to evaluate health department effectiveness in specific areas. Given the changing roles of health departments and the importance of emerging health threats, evaluating the impact of health department structure on emergency preparedness is an important, but lacking, area of research.

Initial research has shown that health department leaders who are experienced, have the ability to persuade, have diplomatic skills and use their discretionary power appropriately (Duncan, et al., 2007) increase the effectiveness of emergency preparedness offices. Additionally

increased local coordination (Koh, Elqura, Judge & Stoto, 2008; Palm & Svoboda, 2008; Stoto, 2008) and health department size (Stoto, 2008) may contribute to emergency preparedness; however most of this research has evaluated local health department, rather than state, planning activities.

There has been some research focused on state emergency preparedness planning and activities (Centers for Disease Control and Prevention, 2008; Holmberg, et al., 2006; Levi, et al., 2008b; Lister & Stockdale, 2007; National Governors Association, 2008), but it has not evaluated the impact of state health department structure on preparedness. The purpose of this study was to evaluate the impact of state health department structure on the effectiveness of state pandemic influenza planning as measured by inclusion of CDC recommendations in written plans.

Methods

Dependent Variable

Based on the CDC's State and Local Pandemic Influenza Planning Checklist (2006c) (Appendix A), a state pandemic plan assessment tool was developed to evaluate the extent to which states' most recent written pandemic flu plans (as of March 2008) incorporated minimum federal recommendations for state preparedness planning. The CDC's Checklist was turned into a matrix that included 85 factors comprising the ten domains described in Table 1 (pg. 20). (A list of all 85 factors is in Appendix B). The factors were individually taken from the CDC Checklist to ensure that each recommendation had its own score. For example, under vaccines, one of the CDC recommendations is "address the needs of vulnerable and hard-to-reach populations in the operation plan." The needs of the vulnerable became one factor, and the needs of the hard-to-reach became another in the measurement tool.

The plans were read and coded; each recommendation had an interval measure of no mention (1), brief mention but no description or action item associated with the factor (2), or in-depth description of the item (3). For example, if a plan mentioned that risk communication was important, but did not explain assessment of communication needs, it received a score of 2; if the plan explained coordination with public partners, it received a score of 3 for that individual factor. By including a three point scale, more information was gleaned about the planning process and comprehensiveness of the plans compared to previous studies which included only dichotomous measures (Lister & Stockdale, 2007) (See Appendix D for frequency scores for each factor).

All data were collected and entered into Excel, cleaned and checked for accuracy and then merged into an SPSS version 16.5 database. Outliers were assessed via visual inspection of distributions and checked for accuracy. Ten state plans were coded and scored by a colleague to evaluate inter-coder reliability (α=0.958).

Each state's domain scores were calculated by adding the scores for each factor within the domain. For example, the leadership and networking domain had 18 factors and a total possible score of 54. Each 1, 2, and 3 was added together to calculate a domain score. In order to create a "total preparedness score" for each state, the unweighted scores of each domain were added together. Previous measures have not applied weighting to their evaluations of multiple preparedness indicators (Centers for Disease Control and Prevention, 2008; Holmberg, et al., 2006; Lister & Stockdale, 2007), and it is not clear that any of the domain areas is more important than others.

Written plans for the 50 United States were collected; 49 states' complete pandemic plans were publicly available on the web site www.pandemicflu.gov or the Council of State and

Territorial Epidemiologists web site (http://www.cste.org/). North Dakota was contacted for its complete plan; however, the state preferred that the 2006 plan summary, available on its web site, be used.

Independent Variable

Ford et al. (2003) utilized qualitative research and cluster analysis in order to identify categories for describing state health department structure. The variables assessed by Ford, et al. were meant to capture key organizational variables because state health agencies have an extensive scope of activities and no single variable can measure their structure. Researchers found five clusters defined as: flexible agencies in unpredictable environments, centralized and stable, complex solutions and chaotic environments, incremental change in bureaucratic environments, and scarce resources for slow change.. Here, Ford et al.'s work was extended by testing their measures of state health department structure to evaluate structural variables' impacts on state written pandemic preparedness plans.

In order to evaluate whether Ford et al.'s (Ford, et al., 2003) clusters were associated with total preparedness score, the mean scores of states in each cluster were compared via the Kruskall-Wallace test for nonparametric comparison of means. There were no significant differences between clusters; however, the number of states in each cluster varied greatly, and significant differences between clusters were not expected. The lack of variance between clusters led to the use of raw scores for predicting preparedness scores.

There were 21 total variables in Ford et al.'s (2003) study (Table 14). Their study utilized cluster analysis to reduce the variables; however, the definitions of the clusters, although appropriate for Ford et al.'s work, were not definitive enough upon which to base the analysis in this study. They assumed mutual exclusivity, whereas for this evaluation, it was believed that

many of the variables could overlap between clusters. The clusters also had varying numbers of states within them (2-18) making comparison across clusters difficult. The purpose of Ford's et al.'s work was to describe and classify health departments based on specific criteria. Here, the purpose was to understand a behavioral output of health departments via their characteristics rather than describe the health departments themselves; therefore, the raw scores were utilized in order to evaluate their impact on preparedness score.

Each of the variables were plotted and visually evaluated for normal distributions. Independent variables were not normally distributed, and non-parametric statistics were used for all analyses. Spearman's rank correlation coefficient was used to evaluate multicollinearity between independent variables. Independent variables correlated with each other above 0.7 were removed. Munificence was significantly and positively correlated with resource ($r=0.744$, $p<.01$); adaptiveness with innovation ($r=.699$, $p<.01$); and multiplexity with integration ($r=.750$, $p<.01$). Munificence, adaptiveness, and multiplexity were removed from the analyses.

Table14. Independent Variable Definitions (Adapted from Ford, et al., 2003)

Variable Label	Definition
Dynamism	Instability in technology, client wishes, and competition.
Heterogeneity	Differences in services provided and resulting differences needed in competitive tactics.
Munificence*	Steady funding, regulatory discretion, adequate workforce, sufficient materials, and favorable demographic trends.
Scanning	Amount of tracking and number of agency members involved in scanning the environment in terms of consumer and administrative issues.
Delegation of operating authority	Amount of authority for day-to-day operational decisions transferred from top managers to managers below.
Centralization of strategy-making power	Distribution of power to make long-term strategic decisions.
Resource availability	Amount of labor, materials, capital, facilities, and other resources within the agency.
Management tenure	Average number of years top managers have held their positions.
Controls	Number and scope of systems to measure performance trends.
Internal Communication	Ease and fidelity with which all kinds of information flows throughout the agency.
Agency differentiation	Degree of differences in goals, administration, behavior, operations, and management style between units or departments in the agency.
Professionalization	Percentage of staff with professional qualifications.
Hierarchy	Number of levels or organizational hierarchy.
Span	Average span of control for base of hierarchy.
Innovation	Amount of innovation used in terms of number and novelty of new services/products.
Adaptiveness/proactiveness*	Amount of response by the agency to external environmental conditions.
Integration of decisions	Degree to which actions in one unit of the agency complement or support those in other units.
Conscious strategic analysis	Amount of time and thought devoted to real or perceive problems and ways to deal with the problems.
Multiplexity*	Range of factors considered by top managers when making strategic decisions.
Futurity of decision	Time frame used by the agency in strategic planning.
Precedents	Degree to which the agency rethinks its strategies and the way in which it will attain its strategies.
*Variables were removed due to multicollinearity. Munificence was significantly and positively correlated with resource ($r=0.744$, $p<.01$); adaptiveness with innovation ($r=.699$, $p<.01$); and multiplexity with integration ($r=.750$, $p<.01$).	

A total of 41 states (excluding DE, IL, ME, MA, MI, SD, TN, UT, and WV) were included in the analysis based on Ford et al.'s (2003) ability to collect sufficient data for analysis. Data were initially analyzed via bivariate Spearman correlations between each of the independent variables and both domain and total preparedness scores. Additionally, to evaluate the predictive power of the independent variables, multiple regression analyses (MRA) were employed using all of the independent variables and composite (total score) from the CDC Checklist as well as each of the ten domain scores evaluated by the preparedness measurement tool. Each of the regression analyses were plotted and visually inspected to ensure residuals were normally distributed.

Results

Two-tailed Spearman correlations showed that tenure was negatively and significantly correlated with surveillance (r=-.308, p=.05) and public health and clinical labs (r=-.482, p=.001). Professionalization was positively and significantly correlated with vaccines (r=.400, p=.010), antivirals (r=.366, p=.019), community disease control and prevention (r=.315, p=.045), communications (r=.402, p=.009). Professionalization was the only variable significantly correlated with total preparedness score (r=.386, p=.013).

The regression analyses offered a number of significant findings which are reported in Table 15. Health department structural variables offered some explanation for pandemic preparedness: total preparedness score (Adjusted R^2=.249), leadership and networking score (Adjusted R^2=.-.005), surveillance score (Adjusted R^2=.175), health care and public health partners score (Adjusted R^2=-.065), infection control and clinical guidelines score (Adjusted R^2=-.042), public health and clinical labs score (Adjusted R^2=.085), vaccines score (Adjusted R^2=.164), antivirals score (Adjusted R^2=.111), community disease control and prevention score (Adjusted R^2=.016),

communications score (Adjusted R^2=.312), and psychosocial considerations score (Adjusted R^2=-.149). Individual variables that were significant in the MRAs are presented in Table 12.

Table 15. Significant Multiple Regression Analyses Results by Independent Variable and Domain

Independent Variable	Domain	B	SE	Beta
Professionalization	Total Score	8.755	.659	2.97**
	HC/PH Partners	1.466	.597	.649*
	Vaccines	1.599	.683	.548*
	Antivirals	.731	.263	.671*
	Communication	1.295	.448	.589**
Tenure	Surveillance	-.048	.013	-.695**
	Labs	-.033	.012	-.529*
	Communications	-.036	.017	-.351*
Hierarchy	Total Score	-10.134	3.501	-2.895**
	Surveillance	-.933	.409	-.615*
Communication	Infection Control	-.952	.402	-.625*
Innovation	Infection Control	-1.028	.431	-.806*
Precedents	Surveillance	1.377	.563	.761*

*p<.05
**p<.01

Discussion

The results of this study can assist researchers and health department officials in understanding how organizational aspects of state health departments may impact health department functioning, and how simple organizational changes can help increase health

department effectiveness in emergency preparedness. The findings show that structural variables may have an influence on preparedness planning as evidenced by the regression analyses. While many of the variables in this study were not statistically significant in the regression models, the overarching fit of each model shows that health department structure may, in fact, be associated with preparedness. This finding was not surprising considering that the "total score" may not be a true reflection of the comprehensiveness of state plans because the score was additive and included all domains. Evaluating each domain individually and the variables that were significant predictors helped to shed more light on the results.

Increases in professional qualifications have been shown to improve productivity and expertise in legislatures (King, 2000), nursing (Moloney, 1992), and health departments (Mullan, 2000). The findings here showed that increased professionalization may also have an impact on public health preparedness. Given the importance of each of these areas in mitigating the impact of a pandemic, health departments should focus on increasing their professional, trained workforce. The difficult economic situation that health departments face in the 2009 financial crisis can make professionalization of the workforce challenging; however, inter-departmental trainings, partnerships with academic institutions, and low-cost distribution of training materials may address this need and improve the functioning of health departments at low-cost.

Tenure's negative association with surveillance, public health and clinical lab, and communication scores was interesting. Health department activities have been focused on surveillance, lab capacity, and internal and external communication throughout their history (Beitsch, et al., 2006) unlike some of the new roles states must undertake in preparedness such as integration with first responder agencies (Nelson, et al., 2007). Stagnation in management of health departments may lead to reduced focus on the traditional roles of health departments,

particularly as resources shift toward changing priorities. Focusing on traditional public health activities and making them priorities may help to decrease the negative impact of tenure on these domains.

Hierarchy was one of the measures of spatial complexity or the breadth and depth an agency leader must manage (Ford, et al., 2003). The negative association between hierarchy and some variables could signify that strong hierarchies in health departments may impede health department core activities. Domestic and international surveillance systems that identify prevalent strains and characterize their effect on human health are key to detecting and treating influenza (United States General Accounting Office, 2003), and they require flexibility in decision making by epidemiologists. Strong hierarchies may reduce independence among employees, and may include cultures that limit individual decision-making which could reduce rapid management and deployment of important resources during a pandemic. Additionally, strong, multi-level hierarchies may impede pandemic planning comprehensiveness as each alteration to a plan may encounter multiple layers of bureaucracy before changes can be made; such situations may result in plans that are limited in scope.

Communication and innovation were negative predictors for the infection control/clinical guidelines domain. Increased internal communications may reduce the focus on partnerships with external agencies including healthcare providers. Such partnerships are imperative in sharing information regarding mitigation of disease through infection control and clinical activities which could explain this finding. Innovation in new services and products may take resources away from more traditional disease prevention methods including clinical mitigation of disease spread. Shifting limited resources from one area to another may reduce the effectiveness of tried and true public health measures (Beitsch, et al., 2006).

Precedents may have been a positive predictor for surveillance scores because the degree to which agencies re-think their strategies could be beneficial to surveillance techniques (Nelson, Thompson, Smith, Harris, Madans, et al., 1997). Surveillance has changed over time through the use of new technology and methodologies. Implementing new strategies for traditional roles may help to keep those areas effective over time.

Overall, internal structure and behavior seem to have the greatest association with pandemic preparedness plan creation which is consistent with other work that has found that structural and strategic variables impact bureaucratic behavior (Hammond, 1986; Meier & Bhote, 2007; Whitford, 2007). Pandemic plan writing is an internal activity which depends upon resources primarily within health departments. Analyses of emergency responses may have different findings as responses depend upon integration with other agencies, and internal health department structures may have less bearing on an effective response.

The research conducted in this study advances the public health systems' research agenda (Lenaway, et al., 2006) by determining how public health agency structure affects performance in preparedness planning; defining and quantifying dimensions of public health systems in emergency planning; evaluating how and to what extent a high-performing public health system is indicative of preparedness; and exploring the effectiveness of state health department structures in public health emergency planning.

Limitations

The states that were excluded from this study included the lowest scoring state (WV) and one of the highest scoring states (MA) overall. The omission of outliers may have allowed for a more accurate evaluation of trends; however, it is unclear if the exclusion of states impacted the results. Additionally, the study focused on 41 states which is not only a small sample, but is also

not the universe, reducing the power of the analysis. If this study was replicated to assess state plans over time the results may look quite different as the sample size could be much larger.

Another limitation of this study was the factors selected for prediction of the outcome variable. The factors were chosen based on Ford et al.'s (2003) work which utilized a variety of variables in order to reduce them to key cluster areas. Here, the factors were evaluated individually, rather than clusters, making for a large number of independent variables with a small sample size which may have skewed the results. It is not entirely clear how Ford defined variables via qualitative analyses of health department documents, and there are inherent limitations in using secondary data for analyses. Additionally, both independent and dependent variables were collected from multiple years which reduced the interpretability of causality. Data were standardized as much as possible with the most up to date plans and independent variables being utilized for all states; however, the findings must be interpreted with caution, as it is not clear that the structural variables were in place prior to plan creation. Future studies should evaluate the impact of structural variables on pandemic plans longitudinally in order to better assess prediction and causality.

Future research may also replicate the study conducted here with other areas of preparedness to evaluate the impact of state health department structure on other emergencies. Similar research should also take place after an event occurs in order to evaluate if the response was impacted by health department structure.

Conclusion

The research conducted in this study offers initial insight into structural factors that predict comprehensiveness of state pandemic plans. The federal government and states have invested billions of dollars in pandemic planning at the state level (United States Department of Health

and Human Services, n.d.). Evaluating how planning resources are spent and understanding why some states have conducted more thorough planning than others can assist those who are less prepared in modifying and improving upon their processes in pandemic planning. Many of these improvements may increase health department effectiveness in other areas of preparedness and traditional public health functions by increasing staff knowledge, reducing red tape, and making health departments more flexible to changing environments.

State health department structure seems to have some impact on pandemic planning, and there are simple steps health departments can take in order to address and improve their functioning including increasing professional development, reducing layers of hierarchy, and increasing communication and collaboration with external partners. Health departments should consider increasing training for their staff via the use of internet tools, partnerships with non profit agencies and universities, and federal resources. Additionally, health departments can make inexpensive structural changes that may increase their effectiveness. Such changes may include increasing decision-making power to lower level staff, ensuring long-term staff have access to training resources to keep their skills fresh, and reducing the layers of bureaucracy, particularly when decisions need to be made quickly. The research conducted here shows that states have clear opportunities to increase their effectiveness for pandemic planning in inexpensive ways that do not depend on external resources.

CHAPTER 5

CONCLUSION

Study Significance

The research study conducted here offers a number of unique contributions to emergency preparedness and public health systems research. The current study utilized the *inventories and capacity instrument* means of evaluating preparedness and developed a standard for assessing whether states meet CDC recommendations (Stoto, et al., 2008) for pandemic planning in their written pandemic plans. Many inventories suffer from some weaknesses such as the presumption of an evidence base linking states' ability to respond with how they perform on various checklists. Previous measures show little consistency in what defines "preparedness," how it should be measured, and rely on subjective capacity measures as self-reported by response agencies. Good measures must be clearly operationalized with required data elements explained (Stoto, et al., 2008).

The tool used in this study overcomes many of the weaknesses of inventories and capacity instruments. While there is still an assumption that capacity is linked to actual response capabilities, the tool created in this study clearly defined preparedness quantitatively and objectively. Rather than depend on the self reporting of individuals within planning agencies, this tool is able to measure plans without the input of plan creators, thereby reducing bias via self-report. Evaluating written plans in this way offers a baseline measurement of one type of preparedness activity because it is the initial step to preparing a community for an emergency. If written plans are not comprehensive, responses will be more likely to have gaps. During a pandemic, many responders and plan creators may be unable to work, ensuring plans are comprehensive will allow substitute staff to step in and respond appropriately.

This study was the first of its kind to offer an in-depth evaluation of state written plans via a clearly defined measurement tool. The use of defined measures allows for replication over time and may offer states reports of their progress from one measurement period to the next. Such an evaluation gives states clear objectives to strive toward, rather than a moving target as happens when evaluation measures continuously change. The use of a three-point scale also helped to capture nuances in state plans that cannot be evaluated via a dichotomous yes/no measure. Currently, there is no "gold standard" for measuring preparedness. Ideally, evaluation tools would have a clear evidence base from which to draw, but since a pandemic has not occurred in over 30 years, it is not clear what will make states more prepared to respond to such an event. In the meantime, the recommendations of experts in infectious diseases and emergency preparedness are the best resources to draw upon for defining preparedness which is why the CDC checklist was chosen to measure pandemic preparedness.

In addition to giving states a sense of how comprehensive their pandemic plans are compared to other states, this study evaluated why some states have been more successful than others including federal recommendations in their plans. Previous research has not evaluated the structural and political mechanisms for increased preparedness, and the findings from this study can help state health departments and government officials understand why they may be less successful at creating comprehensive plans. This was the first time such an evaluation was conducted, and there were many challenges to overcome including choosing what variables to evaluate, the limited availability of data, and the variance in plan years. Additionally, data about the pandemic plans themselves may have been missing as many states choose not to share aspects of their plans. All of these challenges limited the interpretability of the findings. Overall, it is clear that gaps remain in state pandemic planning; however, research such as the work

described here can help move states toward improving their planning to ensure an effective response to a pandemic outbreak via small, inexpensive changes in health departments. State health departments can increase training for staff and reduce bureaucratic red tape in order to empower staff to make rapid decisions in a changing environment. Future research may be able to collect multiple iterations of plans and multiple years of data in order to better evaluate the impact of many of the variables evaluated in this study.

Results Overview

Study findings showed that overall states' greatest strengths were in leadership and networking (Appendix C and D). This finding is likely the result of regular health department activities as some of the key functions of state health departments include coordination among various health agencies, local health departments, and emergency response agencies (Beitsch, et al., 2006). The advent of the National Incident Management System and the Incident Command System has increased agency coordination with other responders as well (Federal Emergency Management Agency, 2007). Bioterrorism, emergency preparedness, and epidemiology are also important functions of state health departments (Beitsch, et al., 2006) as evidenced by increased performance in the surveillance domain.

The greatest gaps among all states in written planning existed in health care and public health partners, infection control and clinical guidelines, antivirals, and workforce support and psychosocial considerations. This is particularly troublesome as health care responders (Lederberg, et al., 1992), infection control (United States Department of Health and Human Services, 2005), and antivirals (Hayden, 1997) are likely to be the most immediate and effective ways to mitigate a pandemic prior to vaccine production. States should expand their focus on

these areas and include health care partners to ensure a pandemic can be addressed in its early stages.

States with the highest overall preparedness scores, New York, Virginia, Maryland, North Carolina, and Massachusetts, may have included more recommendations because of their recent experiences with other emergencies including terrorist attacks, floods, and hurricanes. New York's plan was written in 2006 after the terrorist attacks of September 2001. It is possible that the current pandemic plan was largely influenced by the experience during 9/11, and may be one of the reasons for New York's high scores across domains. Virginia and Maryland's plans were also written in 2006, four years after the sniper attacks throughout Northern Virginia and Maryland and five years after the Pentagon attack in Washington, DC. Those experiences may have influenced pandemic plans since response agencies had to focus extensively on emergency events in close proximity to each other. North Carolina's plan, written in 2007, also had high scores. North Carolina has had numerous hurricanes in recent history and has had to implement emergency response plans on a number of occasions. These four states have had experiences with emergency events, but enough time has gone by to look back and evaluate lessons learned. Such lessons may have influenced the high scores for pandemic planning. Although Massachusetts has not experienced emergencies at the same level as the other states, it has a strong commitment to public health and has invested a great deal in protecting the health of its citizens through the implementation of a universal health care system and extensive public health services which could have influenced its preparedness score.

The second part of this study examined whether any or all of three political models could offer an explanation for state written pandemic preparedness plan inclusion of federal recommendations. While none of the three models – organizational capacity, overhead political

control, or task environment – offered an overwhelming explanation for the outcome of interest, they did show that these models can offer some prediction for preparedness scores. Overhead political control and task environment offered better fits for predicting state plan comprehensiveness than organizational capacity which was a surprising finding, particularly given the focus on funding for public health preparedness. Additionally, the fact that many of the variables analyzed in this study did not definitively explain state preparedness scores is telling in and of itself. A great deal of funding at the state and federal levels has been put forth to increase state preparedness (United States Department of Health and Human Services, 2004); however, it may have less of an impact on state inclusion of federal recommendations than originally thought. State health departments may be at the mercy of external influences which guide and shape its priorities. Income, governor staff, and citizen engagement seem to offer some explanation for preparedness, which may point to the need for health departments to engage the community in their efforts in order to ensure more comprehensive plans.

The evaluation of state health department structure on pandemic preparedness shed more light on why some state pandemic plans are more comprehensive than others. This finding was not surprising because pandemic planning is primarily an internal exercise and subject to the needs and capacity of health department staff. Professionalization in health departments had a strong impact on preparedness. Currently, there is a public health workforce shortage (Perlino, 2006) which poses challenges for traditional public health activities as well as emerging issues such as pandemic planning. Increasing training and expertise of the current workforce is key to beginning to address these challenges, but the findings of this study can also help make the case for increasing investments in public health education in general.

Increased levels of bureaucracy also seemed to have an impact on preparedness. State health departments that have multi-layered hierarchies, have stagnant leadership, take a long time to make decisions, and are inflexible are less prepared for a pandemic. These findings speak to the need for health departments to increase their agility and flexibility in troubling times. The current economic situation emphasizes the need for health departments to take on more responsibilities with fewer resources. States with health departments that can take on these challenges will be more successful at reducing the impact of a pandemic among their populations.

Often health departments that can clearly define their roles and the roles of their partners are far more effective in carrying out their responsibilities. State health departments tend to have more layers of bureaucracy and hierarchy than local health departments which have to get more done with less money and staff. Local health departments must respond directly to community concerns and needs while states are often so far removed from their constituents that they are disconnected from the needs of the community. Although these structural issues are ingrained in the culture of government, small changes can reduce the challenges of ensuring community needs are met. State health departments should work closely with local health department staff to ensure roles and responsibilities are not overlapping and are clearly defined. Additionally, state health departments can create partnerships with local consumer agencies and academic institutions in order to utilize the expertise of others. For example, Pennsylvania's Department of Health maintains a relationship with Temple University's Department of Public Health which ensures that experts in specific aspects of emergency preparedness inform planning.

Future Directions

While some states have included more recommendations than others, the findings show that there is room for improvement among all states in all areas of pandemic preparedness. The impact of current disparities in state planning could mean disproportional responses across the country. A pandemic will not respect jurisdictional boundaries such as national, state, or county lines. States that are unable to implement an effective response immediately upon discovering a novel pathogen that spreads from human-to-human will put neighboring states at risk for rapid spread of disease. Preparing for a pandemic outbreak could potentially save thousands if not millions of lives.

This evaluation is the first of its kind to offer a clearly defined replicable measure for evaluating written pandemic plans. Because of the potential impact of a pandemic on the workforce, written plans must be as comprehensive as possible to ensure substitute staff can respond appropriately. The findings of this study are consistent with previous studies which show that gaps remain in key areas of preparedness (Centers for Disease Control and Prevention, 2008; Holmberg, et al., 2006; Levi, et al., 2008b; Lister & Stockdale, 2007); however, the tool used here offers states clear goals and areas for improvement to ensure states actually improve over time. The benefit of the measurement tool used in this study is its capacity for replication over time, unlike previous evaluations that contain changing or poorly defined measures. States now have an opportunity to improve their plans via clear goals and objectives. Additionally, states should work with neighbors that have better scores to improve their plan, thereby addressing integration across boundaries and ensuring a consistent response across regions.

It is important to note that this measurement tool is only a small piece of measuring preparedness. This, along with other evaluation tools, should be considered together when

measuring emergency preparedness. For example, an evaluation of drills and exercises may find that states include things in practice that are missing from their written plans. Such activities can be easily added to written documents to ensure that they will be included in all response activities, regardless of who is coordinating the response. All preparedness activities should be considered together, rather than in silos of written plans, planning activities, and actual responses. Public health's interdisciplinary perspective is its great opportunity and its challenge. Written plans are primarily an internal process; however, the implementation of such plans will depend upon coordination with a variety of external agencies. Future research must evaluate the ability for health departments to integrate and communicate their plans with other response agencies. Plans that are created in silos will not be properly implemented and may leave millions at risk.

The results of this project show that health department structure offers the best explanation for pandemic plan integration of federal recommendations. The fact that the evaluations of political theory and health department structure included disparate findings speaks to the nuances of state health department activity and the uniqueness of this activity compared to other traditional bureaucratic activities. Additional evaluations of organizational structure such as network analysis or integration between levels of government may offer more insight into emergency preparedness behavior.

Similar research may also be conducted at the federal and international levels in order to evaluate pandemic planning on a larger scale. Although many of the recommendations may differ because of the scope of a more global response, evaluating what makes countries and the international community more prepared can assist in mitigating the impact of a pandemic before it begins.

The tool used here can also be used to measure preparedness for similar events at the local level, offering localities a concrete way to measure their written plan preparedness. It is likely that there is greater disparity between local plans than between state plans as local planning agencies have different levels of resources, expertise, and experience. This measurement tool can also be used to hold states and localities accountable for their activities to ensure they are using resources appropriately.

The approach used here for pandemic flu can be applied to measuring preparedness for other hazards including weather, chemical, biological, radiological, and nuclear events. There are extensive federal recommendations for each of these hazards, and both states and localities would benefit from clear measures to evaluate their planning activities. This is a consistent challenge for many agencies, and a simple tool to evaluate their work could be helpful in prioritizing resources.

In-depth qualitative studies can also be used to evaluate whether the activities and perceptions of preparedness by planners match actual preparedness outcomes. The Delphi Method, key informant interviews, and surveys can be used to glean opinions from planners throughout the country as well. Understanding the processes by which planners create and implement their plans can help researchers to evaluate planning effectiveness and disseminate best practices to assist others in their planning efforts.

Future studies should evaluate other potential factors that impact both written preparedness and preparedness activities. It is possible that other political, administrative, and/or network theory explanations may better explain this bureaucratic activity. Additionally, the type of analysis utilized in this study can be used to evaluate preparedness activities beyond written plans. It is possible that while these models do not explain written plans, they may explain drills

and exercises. It is clear that additional research must be conducted in order to evaluate the resources and activities that increase preparedness at the state level. Resources are allocated without evaluating their impact on preparedness, and it is time to build an evidence base for best practices.

Future work will build on the work completed in this study. Additional tools will be created to measure preparedness and evaluate other activities including drills and exercises. Evaluating the tools used by those who create written plans and exercises is an important area of future research. It is possible that many plan creators have not used CDC recommendations, and that is why there is such variation between plans across states. Future research will also include utilizing organizational and political theory to evaluate pandemic plans over time, other hazard preparedness plans, and drills and exercises. Organizational structure and political actors likely have strong influences on preparedness, and understanding such relationships can help ensure the health and safety of the public in an emergency.

Making the case for preparing for an unpredictable event is challenging in the best of times, but even more so when the stability of the economic and health systems are teetering. The research conducted in this study and future studies can help to make the case for continuously improving public health preparedness in a changing environment by defining and measuring what it means to be prepared. There are clear areas for improvement both in preparedness itself, and understanding the factors that influence preparedness. This study offers states clear goals to strive toward, and it sheds light on the opportunities within health departments to improve their capacity and outcomes. Success will be measured when an emergency occurs and the response is immediate and effective, minimizing morbidity and mortality.

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APPENDIX A

CENTERS FOR DISEASE CONTROL AND PREVENTION STATE AND LOCAL PANDEMIC PLANNING CHECKLIST

STATE AND LOCAL PANDEMIC INFLUENZA PLANNING CHECKLIST

Planning for pandemic influenza is critical. To assist you in your efforts, the Department of Health and Human Services (HHS) and the Centers for Disease Control and Prevention (CDC) have developed the following checklist. It identifies important, specific activities you can do now to prepare. Many are specific to pandemic influenza, but a number also pertain to any public health emergency.

This checklist is based on the HHS Pandemic Influenza Plan, Public Health Guidance for State and Local Partners, but is not intended to set forth mandatory requirements. Each state and local jurisdiction should determine for itself whether it is adequately prepared for disease outbreaks in accordance with its own laws and procedures.

Community Preparedness Leadership and Networking [Preparedness Goal 1—Increase the use and development of interventions known to prevent human illness from chemical, biological, radiological agents, and naturally occurring health threats.]

Completed	In Progress	Not Started	
☐	☐	☐	• Establish a Pandemic Preparedness Coordinating Committee that represents all relevant stakeholders in the jurisdiction (including governmental, public health, healthcare, emergency response, agriculture, education, business, communication, community-based, and faith-based sectors, as well as private citizens) and that is accountable for articulating strategic priorities and overseeing the development and execution of the jurisdiction's operational pandemic plan.
☐	☐	☐	• Delineate accountability and responsibility, capabilities, and resources for key stakeholders engaged in planning and executing specific components of the operational plan. Assure that the plan includes timelines, deliverables, and performance measures.
☐	☐	☐	• Within every state, clarify which activities will be performed at a state, local, or coordinated level, and indicate what role the state will have in providing guidance and assistance.
☐	☐	☐	• Assure that the operational plan for pandemic influenza response is an integral element of the overall state and local emergency response plan established under Federal Emergency Support Function 8 (ESF8): Health and medical service and compliant with National Incident Management System.
☐	☐	☐	• Address integration of state, local, tribal, territorial, and regional plans across jurisdictional boundaries in the plan.
☐	☐	☐	• Formalize agreements with neighboring jurisdictions and address communication, mutual aid, and other cross-jurisdictional needs.
☐	☐	☐	• Ensure existence of a demographic profile of the community (including special needs populations and language minorities) and ensure that the needs of these populations are addressed in the operation plan.
☐	☐	☐	• Address provision of psychosocial support services for the community, including patients and their families, and those affected by community containment procedures in the plan (see Supplement 11).

continued

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Completed	In Progress	Not Started	
☐	☐	☐	• Test the communication operational plan that addresses the needs of targeted public, private sector, governmental, public health, medical, and emergency response audiences; identifies priority channels of communication; delineates the network of communication personnel, including lead spokespersons and persons trained in emergency risk communication; and links to other communication networks (see Supplement 10).
☐	☐	☐	• Identify for all stakeholders the legal authorities responsible for executing the operational plan, especially those authorities responsible for case identification, isolation, quarantine, movement restriction, healthcare services, emergency care, and mutual aid.
☐	☐	☐	• Make clear to all stakeholders the process for requesting, coordinating, and approving requests for resources to state and federal agencies.
☐	☐	☐	• Create an Incident Command System for the pandemic plan based on the National Incident Management System and exercise this system along with other operational elements of the plan.
☐	☐	☐	• Assist in establishing and promoting community-based task forces that support healthcare institutions on a local or regional basis.
☐	☐	☐	• Identify the authority responsible for declaring a public health emergency at the state and local levels and for officially activating the pandemic influenza response plan.
☐	☐	☐	• Identify the state and local law enforcement personnel who will maintain public order and help implement control measures. Determine in advance what will constitute a "law enforcement" emergency and educate law enforcement officials so that they can pre-plan for their families to sustain themselves during the emergency.
☐	☐	☐	• Ensure that the plans are scalable, to the magnitude and severity of the pandemic and available resources. Revise as necessary.

Surveillance [HHS Supplement 1. Preparedness Goal 3—Decrease the time needed to detect and report chemical, biological, or radiological agents in tissue, food, or environmental agents that cause threats to the public's health. Preparedness Goal 5—Decrease the time to identify causes, risk factors, and appropriate interventions for those affected by threats to the public's health.]

Completed	In Progress	Not Started	
☐	☐	☐	• Conduct year-round traditional surveillance for seasonal influenza (e.g., virologic, outpatient visits, hospitalization, and mortality data), including electronic reporting.
☐	☐	☐	• Improve capacity for rapid identification of unusual influenza strains by working with federal partners to enhance laboratory-based monitoring of seasonal influenza subtypes, as described in Supplement 1 (Surveillance).
☐	☐	☐	• Develop and be prepared to implement enhanced surveillance once a pandemic is detected to ensure recognition of the first cases of pandemic virus infection in time to initiate appropriate containment protocols, and exercise regularly.
☐	☐	☐	• Link and routinely share influenza data from animal and human health surveillance systems.
☐	☐	☐	• Obtain and track information daily during a pandemic (coordinating with epidemiologic and medical personnel) on the numbers and location of newly hospitalized cases, newly quarantined persons, and hospitals with pandemic influenza cases. Use these reports to determine priorities among community outreach and education efforts.

Public Health and Clinical Laboratories [HHS Supplement 2. Preparedness Goal 3—Decrease the time needed to detect and report chemical, biological, and radiological agents in tissue, food, or environmental agents that cause threats to the public's health.]

Completed	In Progress	Not Started	
☐	☐	☐	• Institute surveillance for influenza-like illnesses (ILI) among laboratory personnel working with novel influenza viruses.
☐	☐	☐	• Develop and test a plan for surge capacity of public health and clinical laboratories to meet the needs of the jurisdiction during a pandemic.
☐	☐	☐	• Assess regularly the influenza diagnostic testing proficiency and adherence to biosafety containment and biomonitoring protocols.
☐	☐	☐	• Inform frontline clinicians and laboratory personnel of protocols for safe specimen collection and testing, how and to whom a potential case of novel influenza should be reported, and the indications and mechanism for submitting specimens to referral laboratories (see Supplements 3, 4, 5).

Healthcare and Public Health Partners [HHS Supplement 3. Preparedness Goal 6—Decrease the time needed to provide countermeasures and health guidance to those affected by threats to the public's health.]

Completed	In Progress	Not Started	
☐	☐	☐	• Test the operational plan for the healthcare sector (as part of the overall plan) that addresses safe and effective 1) healthcare of persons with influenza during a pandemic, 2) the legal issues that can affect staffing and patient care, 3) continuity of services for other patients, 4) protection of the healthcare workforce, and 5) medical supply contingency plans.
☐	☐	☐	• Ensure all components of the healthcare delivery network (e.g., hospitals, long-term care, home care, emergency care) are included in the operational plan and that the special needs of vulnerable and hard-to-reach patients are addressed.
☐	☐	☐	• Ensure that plan provides for real-time situational awareness of patient visits, hospital bed and intensive care needs, medical supply needs, and medical staffing needs during a pandemic.
☐	☐	☐	• Test the operational plan for surge capacity of healthcare services, workforce, and supplies to meet the needs of the jurisdiction during a pandemic.
☐	☐	☐	• Test the plan provisions for mortuary services during a pandemic.
☐	☐	☐	• Maintain a current roster of all active and formerly active healthcare personnel available for emergency healthcare services.
☐	☐	☐	• Determine what constitutes a medical staffing emergency and exercise the operational plan to obtain appropriate credentials of volunteer healthcare personnel (including in-state, out-of-state, international, returning retired, and non-medical volunteers) to meet staffing needs during a pandemic.
☐	☐	☐	• Ensure healthcare facilities in the jurisdiction have tested a plan for isolating and cohorting patients with known or suspected influenza, for training clinicians, and for supporting the needs for personal protective equipment.
☐	☐	☐	• Ensure the healthcare facilities in the jurisdiction have tested an operational plan to initiate, support, and implement quarantine of potentially exposed healthcare personnel (see Supplements 4 and 5).

Infection Control and Clinical Guidelines [HHS Supplements 4 and 5. Preparedness Goal 6—Decrease the time needed to provide countermeasures and health guidance to those affected by threats to the public's health.]

Completed	In Progress	Not Started	
☐	☐	☐	• Ensure the Health Alert Network in the jurisdiction reaches at least 80% of all practicing, licensed, frontline healthcare personnel and links via the communication network to other pandemic responders (see Supplements 3, 10).
☐	☐	☐	• Craft messages to help educate healthcare providers about novel and pandemic influenza, and infection control and clinical guidelines, and the public about personal preparedness methods.
☐	☐	☐	• Develop and test a plan (as part of the communication plan) to regularly update providers as the influenza pandemic unfolds.
☐	☐	☐	• Ensure appropriate local health authorities have access to EPI-X and are trained in its use.

Vaccine Distribution and Use [HHS Supplement 6. Preparedness Goal 6—Decrease the time needed to provide countermeasures and health guidance to those affected by threats to the public's health.]

Completed	In Progress	Not Started	
☐	☐	☐	• Work with healthcare partners and other stakeholders to develop state-based plans for vaccine distribution, use, and monitoring; and for communication of vaccine status.
☐	☐	☐	• Exercise an operational plan that addresses the procurement, storage, security, distribution, and monitoring actions necessary (including vaccine safety) to ensure access to this product during a pandemic.
☐	☐	☐	• Ensure the operational plan delineates procedures for tracking the number and priority of vaccine recipients, where and by whom vaccinations will be given, a distribution plan for ensuring that vaccine and necessary equipment and supplies are available at all points of distribution in the community, the security and logistical support for the points of distribution, and the training requirements for involved personnel.
☐	☐	☐	• Address vaccine security issues, cold chain requirements, transport and storage issues, and biohazardous waste issues in the operational plan.
☐	☐	☐	• Address the needs of vulnerable and hard-to-reach populations in the operational plan.
☐	☐	☐	• Document with written agreements the commitments of participating personnel and organizations in the vaccination operational plan.
☐	☐	☐	• Inform citizens in advance about where they will be vaccinated.

Antiviral Drug Distribution and Use [HHS Supplement 7. Preparedness Goal 6—Decrease the time needed to provide countermeasures and health guidance to those affected by threats to the public's health.]

Completed	In Progress	Not Started	
☐	☐	☐	• Develop state-based plans for distribution and use of antiviral drugs during a pandemic via the Strategic National Stockpile (SNS), as appropriate, to healthcare facilities that will administer them to priority groups. Establish methods for monitoring and investigating adverse events.
☐	☐	☐	• Test the operational plan that addresses the procurement, storage, security, distribution, and monitoring actions necessary to assure access to these treatments during a pandemic.
☐	☐	☐	• Ensure the jurisdiction has a contingency plan if unlicensed antiviral drugs administered under Investigational New Drug or Emergency Use Authorization provisions are needed.

Community Disease Control and Prevention (including managing travel-related risk of disease transmission) [HHS Supplements 8 and 9. Preparedness Goal 6—Decrease the time needed to provide countermeasures and health guidance to those affected by threats to the public's health.]

Completed	In Progress	Not Started	
☐	☐	☐	• Exercise the jurisdiction's operational plan to investigate and contain potential cases or local outbreaks of influenza potentially caused by a novel or pandemic strain.
☐	☐	☐	• Exercise the jurisdiction's containment operational plan that delineates procedures for isolation and quarantine, the procedures and legal authorities for implementing and enforcing these containment measures (such as school closures, canceling public transportation, and other movement restrictions within, to, and from the jurisdiction) and the methods that will be used to support, service, and monitor those affected by these containment measures in healthcare facilities, other residential facilities, homes, community facilities, and other settings.
☐	☐	☐	• Ensure the jurisdiction has exercised the operational plan to implement various levels of movement restrictions within, to, and from the jurisdiction.
☐	☐	☐	• Inform citizens in advance about what containment procedures may be used in the community.

Public Health Communications [HHS Supplement 10. Preparedness Goal 4—Improve the timeliness and accuracy of communications regarding threats to the public's health.]

Completed	In Progress	Not Started	
☐	☐	☐	• Assess readiness to meet communications needs in preparation for an influenza pandemic, including regular review, exercise, and update of communications plans.
☐	☐	☐	• Plan and coordinate emergency communication activities with private industry, education, and non-profit partners (e.g., local Red Cross chapters).
☐	☐	☐	• Identify and train lead subject-specific spokespersons.
☐	☐	☐	• Provide public health communications staff with training on risk communications for use during an influenza pandemic.
☐	☐	☐	• Develop and maintain up-to-date communications contacts of key stakeholders and exercise the plan to provide regular updates as the influenza pandemic unfolds.
☐	☐	☐	• Implement and maintain, as appropriate, community resources, such as hotlines and Web site, to respond to local questions from the public and professional groups.
☐	☐	☐	• Ensure the provision of redundant communication systems/channels that allow for the expedited transmission and receipt of information.

Workforce Support: Psychosocial Considerations and Information Needs [HHS Supplement 11. Preparedness Goal 6—Decrease the time needed to provide countermeasures and health guidance to those affected by threats to the public's health.]

Completed	In Progress	Not Started	
☐	☐	☐	• Develop a continuity of operations plan for essential health department services, including contingency planning for increasing the public health workforce in response to absenteeism among health department staff and stakeholder groups that have key responsibilities under a community's response plan.
☐	☐	☐	• Ensure availability of psychosocial support services (including educational and training materials) for employees who participate in or provide support for the response to public health emergencies such as influenza pandemics.

continued

Completed	In Progress	Not Started	
☐	☐	☐	• Develop workforce resilience programs and ensure readiness to deploy to maximize responders' performance and personal resilience during a public health emergency.
☐	☐	☐	• Assure the development of public health messages has included the expertise of behavioral health experts (see Supplement 10).

APPENDIX B

85 MEASURED FACTORS

Leadership and Networking
Pandemic Preparedness Coordinating Committee
what is state responsibility
what is federal responsibility
what is federal responsibility
compliance with National Incident Management System
integration across jurisdictional boundaries
formalize agreements with neighboring jurisdictions
demographic profile of community
psychosocial support services
communications plan
authority for operational plan execution (isolation, quarantine, etc.)
process for resource request
Incident Command System
task force to support health care institutions
authority for implementing plan
who has authority? (list)
ID law enforcement personnel
plan is scalable
Surveillance
year round traditional surveillance for seasonal flu
capacity for rapid id of novel strains
share data from local systems
share data from federal systems
track information daily during pandemic
Public health and clinical labs
surveillance for influenza among lab personnel
lab surge capacity plan
assess diagnostic proficiency
inform clinicians and lab personnel about safe specimen collection
how? (list)
Healthcare and public health partners
test operations plan for healthcare sector
all components of healthcare delivery network are in plan
plan provides for real-time awareness of health care needs during pandemic
operational plan for surge capacity
mortuary provisions?
test mortuary provisions
roster of active healthcare personnel available for emergency healthcare
define medical staffing emergency
plan to obtain credentials of volunteer healthcare personnel
exercise plan to obtain credentials of volunteer healthcare personnel
health care facilities have plans for dealing with patients
health care facilities have tested plans for dealing with patients
healthcare facilities have operational plan for exposed h.c. personnel
healthcare facilities have tested operational plan for exposed h.c. personnel
Infection Control and Clinical Guidelines
Health Alert Network reaches 80% of frontline healthcare personnel
messages to educate healthcare providers
types of messages (list)
test plan to update providers as pandemic unfolds
local health authorities have access to EPI-X

Vaccines
plan for distribution, use, monitoring
exercise operational plan ensuring access to vaccine
tracking number of vaccine recipients
vaccine priority
distribution plan
security and logistics
vaccine security (maintain integrity of vaccine)
needs of vulnerable
needs of hard-to-reach
written agreements for personnel participation in distribution
written agreements for organization participation in distribution
inform citizens about vaccination locations
cost of vaccines addressed
Antivirals
state-based plan for distribution and use of antiviral drugs via SNS
test operational plan for procurement
contingency plan for unlicensed antiviral drugs
antiviral priority
cost addressed
Community Disease Control and Prevention
plan to investigate potential cases
plan to contain potential cases
containment plan for isolation
containment plan for quarantine
Federal authority for implementing containment plans
State authority for implementing containment plans
Local authority for implementing containment plans
methods of support for contained
operational plan for restriction of movement
inform citizens
Public Health Communications
assess readiness to meet communications needs
plan and coordinate emergency communication activities with public partners
plan and coordinate emergency communication activities private partners
train subject-specific spokespersons
p.h. communication staff training on risk communication
maintain up to day contact lists of key stakeholders
implement community resources (web, hotlines, etc.)
provision of redundant communication systems
Workforce Support: Psychosocial Considerations and Information Needs
COOP plan for health department services
availability of psychosocial support services
develop workforce resilience programs
development of public health messages (including m.h. messages)
Total Score

APPENDIX C

STATE SPECIFIC SURVEILLANCE DATA

State	Leadership/ Networking Scores	Surveillance Scores	PH/Clin Labs Scores	HC/PH scores	Infection Control Scores	Vaccines Scores	Antiviral Scores	Comm Disease Control Scores	Comm. Scores	Psychosocial Scores
Alabama	72%	73%	75%	60%	33%	69%	73%	53%	75%	50%
Alaska	63%	47%	42%	55%	50%	67%	53%	67%	54%	42%
Arizona	69%	100%	67%	62%	67%	67%	73%	93%	71%	83%
Arkansas	74%	93%	67%	60%	58%	64%	53%	87%	75%	67%
California	69%	60%	67%	55%	50%	69%	53%	57%	71%	50%
Colorado	72%	87%	42%	57%	50%	74%	60%	80%	54%	42%
Connecticut	85%	47%	58%	57%	58%	36%	40%	77%	79%	67%
Delaware	81%	80%	58%	50%	50%	59%	67%	57%	38%	50%
Florida	72%	87%	75%	52%	58%	67%	60%	83%	54%	58%
Georgia	59%	87%	67%	45%	42%	67%	60%	50%	50%	33%
Hawaii	70%	93%	58%	52%	50%	64%	53%	80%	67%	58%
Idaho	74%	73%	67%	55%	50%	62%	67%	70%	63%	67%
Illinois	85%	73%	58%	67%	50%	64%	80%	77%	79%	58%
Indiana	72%	87%	33%	57%	42%	41%	47%	77%	58%	67%
Iowa	56%	60%	75%	48%	58%	46%	53%	50%	46%	50%
Kansas	72%	73%	58%	38%	42%	62%	47%	33%	67%	33%
Kentucky	72%	80%	83%	55%	58%	77%	60%	77%	75%	92%
Louisiana	63%	67%	83%	50%	67%	77%	53%	77%	75%	67%
Maine	69%	67%	33%	52%	67%	62%	67%	93%	92%	50%
Maryland	76%	100%	83%	71%	42%	67%	53%	97%	79%	100%
Massachusetts	83%	73%	83%	76%	75%	90%	60%	80%	79%	92%
Michigan	76%	93%	83%	55%	75%	72%	73%	70%	63%	50%

State	Leadership/ Networking Scores	Surveillance Scores	PH/Clin Labs Scores	HC/PH scores	Infection Control Scores	Vaccines Scores	Antiviral Scores	Comm Disease Control Scores	Comm. Scores	Psychosocial Scores
Minnesota	67%	87%	83%	64%	58%	62%	73%	97%	67%	67%
Mississippi	76%	53%	33%	45%	50%	69%	67%	53%	71%	42%
Missouri	54%	60%	50%	38%	50%	64%	53%	40%	50%	67%
Montana	70%	60%	58%	45%	50%	51%	47%	53%	54%	42%
Nebraska	61%	93%	50%	33%	42%	62%	40%	50%	58%	33%
Nevada	76%	80%	42%	48%	83%	59%	53%	57%	88%	33%
New Hampshire	85%	93%	50%	48%	67%	54%	53%	83%	58%	58%
New Jersey	81%	67%	67%	57%	67%	59%	60%	43%	79%	83%
New Mexico	69%	60%	42%	52%	50%	51%	53%	57%	50%	58%
New York	81%	93%	83%	57%	58%	67%	60%	87%	100%	75%
North Carolina	91%	73%	67%	62%	67%	69%	67%	87%	88%	100%
North Dakota	56%	80%	42%	45%	67%	33%	40%	47%	50%	33%
Ohio	59%	67%	50%	60%	50%	64%	53%	57%	75%	33%
Oklahoma	74%	67%	75%	64%	67%	69%	80%	70%	63%	83%
Oregon	80%	73%	75%	52%	67%	49%	60%	70%	79%	83%
Pennsylvania	69%	73%	58%	50%	58%	69%	73%	70%	67%	58%
Rhode Island	74%	67%	50%	60%	58%	69%	73%	47%	71%	50%
South Carolina	52%	60%	42%	43%	50%	54%	40%	50%	38%	33%

State	Leadership/ Networking Scores	Surveillance Scores	PH/Clin Labs Scores	HC/PH scores	Infection Control Scores	Vaccines Scores	Antiviral Scores	Comm Disease Control Scores	Comm. Scores	Psychosocial Scores
South Dakota	78%	93%	50%	62%	67%	64%	80%	77%	88%	92%
Tennessee	59%	87%	92%	62%	50%	59%	53%	90%	67%	58%
Texas	74%	67%	58%	52%	75%	72%	73%	33%	67%	58%
Utah	59%	67%	33%	40%	50%	51%	40%	47%	50%	33%
Vermont	72%	73%	42%	43%	58%	64%	60%	90%	54%	83%
Virginia	72%	73%	75%	57%	50%	87%	73%	97%	92%	92%
Washington	74%	87%	67%	50%	42%	49%	53%	67%	71%	75%
West Virginia	41%	33%	42%	38%	33%	41%	47%	37%	38%	42%
Wisconsin	72%	80%	33%	60%	67%	59%	47%	43%	63%	58%
Wyoming	69%	100%	92%	52%	92%	62%	53%	77%	58%	42%

APPENDIX D

FACTOR SCORE FREQUENCY TABLE

Factor	**Scores**		
	1	**2**	**3**
Leadership and Networking			
Pandemic Preparedness Committee	13	10	27
timelines, deliverables, performance measures	15	21	14
what is state responsibility	4	14	32
what is local responsibility	4	11	35
what is federal responsibility	4	11	35
compliance with NIMS	10	25	15
intigration across jurisdictional boundaries	3	30	17
formalize agreements with neighboring jurisdictions	22	17	11
Demographic profile of community	42	5	3
Psychosocial support services	14	24	12
communications plan	4	19	27
Authority for operational plan execution (isolation, quarantine, etc.)	7	13	30
process for resource request	16	21	13
Incident Command System	4	15	31
task force to support health care institutions	41	4	5
Authority for implementing plan	7	22	21
ID law enforcement personnel	34	10	6
plan is scalable	8	30	12
Total Score Range		22-49	
Surveillance			
year round traditional surveillance for seasonal flu	3	16	31
Capacity for rapid id of novel strains	10	24	16
share data from local systems	2	11	37
share data from federal systems	8	28	14

track information daily during pandemic	23	14	13
Total Score Range		5-15	
Public health and clinical labs			
surveillance for influenza among lab personnel	37	8	5
lab surge capacity plan	13	27	10
assess diagnostic proficiency	14	17	19
Inform clinicians and lab personnel about safe specimen collection	18	17	15
Total Score Range		4-11	
Healthcare and public health partners			
test operations plan for healthcare sector	39	11	0
all components of healthcare delivery network are in plan	13	24	13
plan provides for real-time awareness of health care needs during pandemic	21	20	9
operational plan for surge capacity	12	24	14
Mortuary provisions?	14	22	14
test mortuary provisions	47	2	1
roster of active healthcare personnel available for emergency healthcare	15	17	18
define medical staffing emergency	40	9	1
plan to obtain credentials of volunteer healthcare personnel	10	21	19
exercise plan to obtain credentials of volunteer healthcare personnel	46	3	1
health care facilities have plans for dealing with patients	15	17	18
health care facilities have tested plans for dealing with patients	50	0	0
healthcare facilities have operational plan for exposed h.c. personnel	23	15	12
healthcare facilities have tested operational plan for exposed h.c. personnel	50	0	0
Total Score Range		14-32	
Infection Control and Clinical Guidelines			
Health Alert Network reaches 80% of frontline healthcare personnel	8	31	11
messages to educate healthcare providers	7	30	13
test plan to update providers as pandemic unfolds	36	12	2
local health authorities have access to EPI-X	36	13	1
Total Score Range		10-29	

Vaccines			
plan for distribution, use, monitoring	1	28	21
exercise operational plan ensuring access to vaccine	33	14	3
tracking number of vaccine recipients	7	14	29
vaccine priority	2	13	35
distribution plan	2	31	17
security and logistics	8	30	12
vaccine security (maintain integrity of vaccine)	17	24	9
needs of vulnerable	20	25	5
needs of hard-to-reach	30	17	3
Written agreements for personnel participation in distribution	29	14	7
Written agreements for organization participation in distribution	30	14	6
Inform citizens about vaccination locations	23	22	5
cost of vaccines addressed	40	7	3
Total Score Range		13-35	
Antivirals			
state-based plan for distribution and use of antiviral drugs via SNS	3	27	20
test operational plan for procurement	42	5	3
contingency plan for unlicensed antiviral drugs	28	18	4
Antiviral priority	6	20	24
cost addressed	36	9	5
Total Score Range		6-12	
Community Disease Control and Prevention			
plan to investigate potential cases	8	20	22
plan to contain potential cases	11	20	19
containment plan for isolation	7	28	5
containment plan for quarantine	8	25	17
Federal authority for implementing containment plans	29	12	9
State authority for implementing containment plans	11	9	30
Local authority for implementing containment plans	27	12	11

Methods of support for contained	17	18	15
operational plan for restriction of movement	16	18	16
Inform citizens	20	23	7
Total Score Range		10-29	
Public Health Communications			
assess readiness to meet communications needs	25	16	9
plan and coordinate emergency communication activities with public partners	5	33	12
plan and coordinate emergency communication activities private partners	7	36	7
train subject-specific spokespersons	11	25	14
p.h. communication staff training on risk comm	24	18	8
Maintain up to day contact lists of key stakeholders	18	27	5
implement community resources (web, hotlines, etc.)	3	17	30
provision of redundant communication systems	16	12	22
Total Score Range		9-24	
Workforce Support: Psychosocial Considerations and Information Needs			
COOP plan for health department services	21	23	6
availability of psychosocial support services	14	16	20
develop workforce resilience programs	27	10	13
Development of public health messages (including m.h. messages)	23	20	7
Total Score Range		4-12	
Code 1, 2, 3 1 = No Mention 2 = Mention but no action 3 = action item			