ABSTRACT

Oberdorfer, Joseph R., The avian influenza pandemic and physicians' perception of preparedness. Master of Science (Biomedical Sciences), May, 2008, 77 pp., 5 tables, 3 figures, bibliography 84 titles.

Prepared physicians may reduce the mortality and morbidity in patients affected during an avian influenza pandemic. However, repeated surveys of preparedness in physicians indicate that physicians are not confident in the preparedness plans. A survey of 86 physicians was performed to test the perception of preparedness. Multivariable regression analysis indicated that predictors of male gender, OR=29.5, 95%CI=1.172-740.541, ability to access the internet, OR=0.4, 95%CI=0.250-0.779, patient education efforts, OR=2.9, 95%CI=1.403-6.163, utilization of electronic records, OR=1.1, 95%CI=1.123-3.514, practicing physical manipulation, OR=1.6, 95%CI=1.022-2.432, and knowledge of government plans, OR=0.5, 95%CI=0.250-0.974, predict better physician preparedness, which was defined as an aggregate score of knowledge and capacity to avian influenza pandemic planning. These results suggest an understanding of the relationship of knowledge and capacity is important in developing a better understanding of physician perception of preparedness.

THE AVIAN INFLUENZA PANDEMIC AND PHYSICIANS' PERCEPTION OF PREPAREDNESS

Joseph R. Oberdorfer, B.S.

APPROVED:

Major Professor

Committee Member

Committee Member

University Member

Chair, Department of Primary Care Clinical Research

Dean, Graduate School of Biomedical Sciences

THE AVIAN INFLUENZA PANDEMIC: PRIMARY CARE PHYSICIANS' PERCEPTION OF PREPAREDNESS

THESIS

Presented to the Graduate Council of the

Graduate School of Biomedical Sciences

University of North Texas

Health Science Center at Fort Worth

in Partial Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

Joseph R. Oberdorfer, B.S.

Fort Worth, Texas

May 2008

ACKNOWLEDGEMENTS

The author would like to thank the members of the committee, Roberto Cardarelli, Martha Felini, and John Licciardone, for their mentorship and assistance in the process of developing and conducting this research project. In addition, special thanks to Raquel Hampton for the insights into survey development and analysis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

CHAPTER ONE

INTRODUCTION

Rationale

Concern and reaction to the possibility of avian influenza virus (AIV) pandemics have resulted in world and national health organizations releasing numerous recommendations for avian influenza pandemic planning (United States Department of Health & Human Services, 2007)(CDC, 2005)(Writing Committee of the Second World Health Organization Consultation on Clinical Aspects of Human Infection with Avian Influenza A (H5N1) Virus et al., 2008). The recommendations were made for federal and state pandemic planning efforts, and now these recommendations are used by local governmental agencies for preparing the local response to an eventual pandemic(CDC, 2005)(WHO, 2008). Prepared physicians have been deemed necessary in a pandemic to prevent excessive loss of lives; however, repeated surveys have shown that physicians do not feel prepared to deal with an avian influenza outbreak (American Public Health Association, 2008)(Business Wire, 2005)(Beaumont, Duggal, Mahmood, & Olowokure, 2007)(Cole, 2006). Although physicians have been inundated with these recommendations, they remain unprepared. Is the failure of physicians to feel prepared related to their perception of what is necessary for preparedness?

Statement of Purpose

It is important to better understand physicians' perception of preparedness, and eventually understand the effectiveness of current efforts by government and academic organizations to provide information to physicians on predictors of avian influenza preparedness. By better understanding physician perceptions of avian influenza preparedness plans it may be possible to enhance the preparedness of physicians by addressing these perceptions in future education and research efforts.

Research Questions

Do the perceptions of avian influenza pandemic preparedness differ among prepared and unprepared physicians?

What physician beliefs, practice, and demographic factors are associated with prepared physicians compared to unprepared physicians?

Delimitations

Surveys were sent to clinicians and non-clinicians who were in an E-mail database of the Osteopathic Primary Care Journal and the Texas Osteopathic Medical Association. The database included physicians, Ph.Ds, registered nurses, and office staff. Only physician responses were included in this analysis due to non-response from other groups. Participating physicians were from all areas in the United States, in fields including Internal Medicine, Family Medicine, Pediatrics, Emergency Medicine, and Surgery.

Physicians were surveyed about perceived preparedness using questions pertaining to knowledge, capacity, treatment preferences, and management of avian influenza virus infections. The questions used were taken from federal pandemic plans and recommendations or knowledge of pandemic influenza by best available medical literature. Physicians were not asked specific local pandemic plans at their practice site.

Limitations

The major limiting factor to the study could be a low response rate. The response rate, if low, could lead to selection bias. Some reasons for a low response rate could include respondents with non-functioning E-mails that were supplied by the database. Also, respondents may not be able to respond due to some condition or hardware/software incompatibility with the survey. The survey software prevented partial responses or basic demographic information of those that refused or did not respond by E-mail. Finally, respondents may choose not to participate for numerous reasons including disinterest in the subject matter, or they may feel it is not related to their field of practice or study. Also, no incentive was provided for taking this survey, such as CME credit. The population surveyed was a journal E-mail database which did not include just physicians, but other academics, including Ph.Ds, registered nurses, and office staff. The occupation of all the members in the database was unknown to the researcher. If these respondents did not contact researchers about their non-physician status, they remained in the denominator when calculating the response rate.

Other limitations include small sample size and the use of a non-validated survey. The survey was not timed; therefore, the time needed to take the survey between responders was unmeasured. As a consequence, the number of responses may limit the conclusions that will be made. Given there are no formal guidelines of preparedness in an AIV pandemic, the definition of preparedness used in this study is an aggregate score based on recommendations from experts and governmental agencies. No objective measures were feasible, as would a site or office inspection provide, due to the broad population sampled and the limited resources of the investigator.

Assumptions

Physicians taking the study were honest about their responses and did not use outside information to complete the survey's knowledge and capacity-based questions.

Physicians' opinions on predictors of preparedness were based on common preparedness planning recommendations and best available medical literature between responders.

Definition of the Terms

Preparedness: Preparedness will be defined as the knowledge and capacity of a physician to respond to a potential AIV pandemic. Proper preparedness has been suggested as an ability to respond to threats and prevent the unnecessary loss of life (Dudley & McFee, 2005). In order for this to be achieved the national policy initiatives must be translated to local programs and policies(McFee, Leikin, & Kiernan, 2004). The knowledge and capacity of a physician were tested with questions based on recommendations from governmental and international agencies and best available medical literature on predictors of preparedness (Appendix A and F).

Predictors of Preparedness: The factors necessary for a prepared response to any pandemic are called predictors. The utilized predictors for physician preparedness in an event of an Avian Influenza pandemic were based on subjective recommendations developed by experts from governmental agencies, such as the Centers for Disease Control (CDC), the World Health Organization (WHO), and the US Department of Human Health Services (HHS) (Table 1). The beliefs of physicians about the importance of predictors were evaluated using responses on a Likert scale.

Table 1 Predictors identified by government and international agencies as important to preparedness

Predictor	Source
Diagnostic Testing	HHS
HR Planning	CDC
Patient Knowledge/Education	HHS
L/S/F Pandemic Influenza Plan Knowledge	HHS
Knowledge of Virus Symptoms/Sequelae	HHS
Rationing Prescriptions/Interventions	WHO
Quarantine	HHS
Personal Protection/Prevention	HHS,CDC
Treatment	HHS,CDC,WHO
Electronic Medical Records	CDC
Internet Access	CDC
Recognition of Respiratory Failure	HHS
Physical manipulation	JAOA
Veterinarian Relationship/Animal Surveillance	WHO

CDC=Centers for Disease Control and Prevention, HHS=US Department of Health and Human Services, JAOA=Journal of the American Osteopathic Association, WHO=World Health Organization, HR=Human resources, L/S/F=Local/State/Federal.

Importance of the Study

The 1918-1919 influenza pandemic resulted in an estimated 50 million deaths worldwide. Predictions for the next avian influenza pandemic have ranged between 2 million and 50 million deaths (WHO, 2007). The total affected world population could range between 20 to 50 percent (WHO,). Current efforts to reduce the consequence of an eventual pandemic are focused on planning for prepared and effective health providers (WHO, 2007).

Governmental agencies feel that preparedness and planning are necessary to avoid a catastrophic loss of lives if a pandemic were to occur (WHO, 2005). However, physicians may not have received adequate information on how to be prepared for an influenza outbreak, even though government plans have been revised and available since 2005 (American Public Health Association, 2008)(Business Wire, 2005)(Beaumont et al., 2007)(Cole, 2006). The main goals of these plans include reduction of mortality and morbidity, ensuring care for large numbers of people, and decreasing social and economic disruptions (CDC, 2008; United States Department of Health & Human Services, 2007; WHO, 2007). Currently there is no evidence that a flu pandemic can be predicted, therefore the need for preparedness is of major importance (WHO, 2008). This study will attempt to gain knowledge of physician perceptions and qualities that were associated with the achievement of preparedness.

CHAPTER TWO

LITERATURE REVIEW

Description of Avian Influenza Virus

Avian influenza viruses (AIV) are members of the *Orthomyxoviridae* family, and the *Influenzavirus* A genus. The Influenza A virus contains two glycoproteins, hemagglutinin (HA) and neuramidase (NA)(Escorcia et al., 2008). Influenza A and B viruses cause epidemic disease in humans, where influenza A viruses commonly infect humans, ducks, chickens, pigs, whales, horses and seals, and influenza B viruses circulate widely only among humans. Influenza C viruses do not cause epidemics or pandemics (Conly & Johnston, 2004).

Current influenza viruses identified as causing illness and deaths in humans include H5N1, H2N9, and H7N7 (Basler, 2007)(Conly & Johnston, 2004) Fifteen H subtypes and 9 N subtypes have been identified with N5 subtypes shown to cause the most virulence in bird populations (Conly & Johnston, 2004). Since all past outbreaks have been caused by viruses of H5 and H7 subtypes, current efforts in research have centered on these subtypes (WHO, 2008).

Because the limiting factor for pandemic avian influenza is the ability of AIV to spread between humans, it is important to understand how the virus infects humans. The AIV is transmitted by inhalation of infectious droplets and droplet nuclei by direct contact or indirect (fomite) contact. The virus then inoculates the upper respiratory mucosa by binding to the mucosa using the HA to attach to the host cells (Conly & Johnston, 2004). The recognition of the host cells by the HA subtype is thought to be related to the structural topology of the human alpha2-6 sialylated glycans (Chandrasekaran et al., 2008). Current research indicates that the binding of avian influenza A viruses to long alpha2-6 sialylated glycans on host cells may result in stabilization of human to human spread (Chandrasekaran et al., 2008). The role of NA protein is thought to be as an enzyme that allows the virus to replicate and promote viral penetration into cells and result in production of pro-inflammatory cytokines such as interleukin-1 and tumor necrosis factor (TNF) (Conly & Johnston, 2004). These cytokines may be the cause of overt respiratory failure seen in avian influenza infections.

Animal to human transmission occurs with exposure to ill poultry, and is the primary means that humans are currently infected with avian influenza virus. This includes the butchering, plucking, and consumption of undercooked poultry (J. H. Beigel et al., 2005). Birds that survive influenza infection will continue to shed the virus for 10 days which allows for the spread to other healthy birds (Conly & Johnston, 2004). The avian influenza viruses are transmitted from farm to farm by movement of birds and infected people. H5N1 has been shown to survive in bird feces for 35 days at low temperature (4°C), and up to 6 days at 37°C(WHO, 2005). In addition, pigs with H5N1 infections were identified in China and it is unclear if there is a connection between the spread of avian influenza to swine and an AI pandemic (Conly & Johnston, 2004).

Other possible modes of transmission include oral ingestion of contaminated water during swimming and direct intranasal or conjunctival inoculation during exposure to water. Also, poultry feces can have large amounts of virus, and in some countries is used as a fertilizer and is another possible mode of transmission (J. H. Beigel et al., 2005).

The theory that wild bird species were the cause of the global spread of previous AIV pandemics has been tested. Recent studies of transmission of H5N1 between bird species (including house sparrows, European starlings, and Carneux pigeons) showed susceptibility of severe infection; 66-100% of birds died within 4 to 7 days. High levels of virus were shed, especially in starlings. Recent influenza (H5N1) viruses are pathogenic for small terrestrial bird species which adds to the worry that an avian influenza pandemic could be spread by migratory birds as well (Boon et al., 2007).

Pandemics occur when reassortment between a human influenza virus and an avian influenza virus allows introduction of a novel virus into the human population. Most importantly, pandemics are unpredictable and have a high morbidity and mortality, with social and economic impacts. Social disruption will especially be great when services in healthcare, public safety, power, food supply, transportation, and communications are affected (CDC, 2005).

The symptoms of avian influenza A (H5N1) viruses in humans usually begin after an incubation period, most commonly, 2 to 4 days in length. However, there have been cases of incubation periods reaching up to 17 days. This could be the result of improper reporting by the infected individual of onset of symptoms or poor recollection of exposure to infected individuals or poultry (J. H. Beigel et al., 2005). In reports from Thailand, the median time of onset of acute respiratory distress syndrome was 6 days after symptoms first developed (J. H. Beigel et al., 2005).

AIV (H5N1) infections are characterized by systemic viral dissemination, high cytokine levels and multiorgan failure in previously healthy people. Gastrointestinal and encephalitis also occur. However, most common symptoms include fever (more than 38°C), cough, and shortness of breath that progresses rapidly to respiratory distress syndrome (J. Beigel & Bray, 2008)(J. H. Beigel et al., 2005). Other less common symptoms include myalgia, diarrhea, abdominal pain, vomiting, sputum production, rhinorrhea, hemoptysis, epistaxis, pulmonary infiltrates, lymphopenia, thrombocytopenia, cardiac dilatation, and supraventricular tachyarrhythmias (J. H. Beigel et al., 2005). These clinical features are not sufficiently specific to make a clinical diagnosis and further history, such as contact with birds is required (PC Gruber, Gomersall CD, & Joynt GM, 2006).

Common laboratory findings in AIV infections are leukopenia (lymphopenia) and mild thrombocytopenia. In addition, there are mild to moderate elevations in aminotransferase levels. Reports of hyperglycemia and elevated creatinine levels are also seen. Thailand reports show increased risk of death among patients with decreased leukocyte, platelet, and lymphocyte counts (J. H. Beigel et al., 2005).

Diagnoses by rapid antigen tests were less sensitive than RT-PCR assays. Also the detection of viral antigens was higher in pharyngeal than nasopharyngeal swabs, which was confirmed with decreased replication of virus in nasopharyngeal mucosa studies(J. H. Beigel et al., 2005). Virus RNA has been found in fecal samples from infected human subjects, suggesting viral replication in the GI tract(J. H. Beigel et al., 2005).

Confirmation of AIV requires one or more of the following: a positive viral culture, a positive PCR assay for influenza A (H5N1) RNA, a positive immunofluorescence test for antigen with the use of monoclonal antibody against H5, and a fourfold rise in H5-specific antibody titer in paired serum samples(J. H. Beigel et al., 2005). The virus levels in tracheal aspirate decrease as the illness progresses, therefore early diagnosis is important.(He et al., 2008) There are few medical interventions for the treatment of AIV infections. The use of antiviral medications and vaccines are currently the best medical treatments. Antiviral drugs are directed at one of two targets, the viral ion channel (M2), and the viral neuraminidase.

In 2006 the CDC issued an alert in which M2 inhibitors, such as rimantadine (Flumadine) and amantadine (Symmetrel), were resisted by influenza A virus (H3N2) due to a specific mutation (Ser32Asn).(Hayden, 2006) However, M2 inhibitors were effective in the 1968 pandemic and the 1977 "Russian Influenza" endemic, and therefore it may be important to continue to stockpile M2 inhibitors.(Hayden, 2006)

Current resistance to Neuraminidase inhibitors (e.g. oseltamivir (Tamiflu)) was reported to be less than 0.5 percent in 2287 community isolates collected worldwide between 1999 to 2002.(Hayden, 2006) H5N1 is currently susceptible to oseltamivir, however the His274Tyr mutation, which causes high-level oseltamivir resistance, has been detected(Hayden, 2006). However, zanamivir (Relenza) is completely effective in oseltamivir resistant strains of H5N1.(Hayden, 2006) It is for these reasons that neuraminidase inhibitors, oseltamivir and zanamivir, are the antiviral medications most recommended for treatment of suspected AIV infections (Basler, 2007).

Although stockpiling efforts by the world's countries has begun, the CDC has estimated that vaccine and antiviral supply will be inadequate in all countries at the start of the pandemic (CDC, 2008). Therefore, special emphasis for planning has been on non-pharmaceutical interventions and pandemic planning.

The FDA recently announced the approval of a vaccine for human use against H5N1. The clinical trial found out of 103 adults receiving the vaccine, 48 percent developed sufficient antibodies to be immune to contracting avian influenza (Hruby & Hoffman, 2007)(CDC, 2008). However, there are still improvements that must be made to the vaccines and the accessibility of vaccines to target populations (Mossad, 2007). Vaccine production is time-consuming and expensive requiring long lead times. Current vaccine production capacity will only produce an estimated 700 million vaccinations in an estimated time period of 9 months. Also, 85% of the world's population does not have the capability of producing vaccines in their own country (Normile, 2008).

A faster vaccine production technique is currently being developed, that does not require the use of eggs. In the future, it may be possible to begin production in 1 to 2 weeks after receiving virus samples, however this is still in development (Normile, 2008).

An unusual effect of vaccination of bird populations is faster antigenic drift in human and avian influenza viruses (Escorcia et al., 2008). It is unknown how this will affect the reliance on vaccination as an answer for the current avian influenza threat.

Epidemiology of Avian Influenza

Whether a pandemic will occur is an important question that cannot be accurately predicted. The AIV has met all requirements for the start of a pandemic, except that it has not been able to spread between humans in a sustained manner (CDC, 2008)(Conly & Johnston, 2004)(J. H. Beigel et al., 2005). The WHO and CDC issued a report in December 2004 warning that a pandemic had a greater likelihood with the spread of the H5N1 virus in bird populations(McFee, 2007). Between 2003 to 2007 outbreaks of AIV in bird populations have occurred in Vietnam (2,373), Thailand (1,137), France, Germany, Jordan, United Kingdom, Denmark, Kazakhstan, Djibouti, Cameroon, and Saudi Arabia with 1 outbreak each.(McFee, 2007) (Conly & Johnston, 2004) Since the end of 2005 to the present, the number of countries reporting AIV cases increased from 17 to sixty(Garrett & Fidler, 2007). Outbreaks of highly pathogenic avian influenza in poultry are considered rare, with only 24 outbreaks since 1959. However, the frequency of these outbreaks has increased, with 14 of these outbreaks occurring in the past decade (WHO, 2008).

Three hundred forty-nine confirmed cases of human H5N1 infection have been identified in fourteen countries, predominantly in southeast Asia (WHO, 2008). Of these human cases, the case-fatality rate was sixty-two percent(CDC, 2008). Case fatality rate has been high among young adults older than 13 years of age. However, there is recent evidence of high case fatality rates among children below the ages of fifteen (J. H. Beigel et al., 2005). The CDC has predicted, based on current models of disease transmission, a new pandemic in the U.S. would affect 30% of the U.S. population and result in 200,000 to 2 million deaths(CDC, 2008).

Past Influenza Pandemics

There have been 12 probable pandemics in the past 400 years, most of which originated in China, Russia or Asia (Hsieh et al., 2006). All three pandemics that occurred in the 20th century were caused by avian influenza. In 1997, H5N1 avian influenza virus was isolated from poultry in Hong Kong. The virus has since spread into bird populations in Asia, Europe and Africa. The H5N1 virus has established a permanent niche in poultry in Asia (CDC, 2007). The 1918-1919 Spanish Influenza (H1N1) Pandemic caused at least 50 million deaths with most deaths occurring within 2 days of infection, and over half of those affected were young, healthy adults(McFee, 2007). The 1957 Asian Flu (H2N2) Pandemic caused 2 million worldwide deaths and the 1968 Hong Kong Flu (H3N2) caused 1 million worldwide deaths(McFee, 2007). These pandemics tended to occur more frequently in spring and summer months (Hsieh et al., 2006). The illnesses of the 1957 and 1968 pandemics were confined to the respiratory system, while the 1918 pandemic and human H5N1 cases caused multisystem dysfunction (Hsieh et al., 2006). The adaption of the pandemic viruses to human hosts, in the 20th century, differed. The 1918 pandemic virus developed when an animal virus spread and adapted to humans. The 1957 and 1968 viruses developed after reassortment between an animal influenza virus and human influenza virus yielded a new, and potentially less virulent virus (Belshe, 2005). This fact may explain the difference in mortality caused by these pandemics.

Past pandemics took 6 to 9 months to cover the entire globe. However, with today's greater travel options on international flights, the initial spread could be weeks to months if a pandemic were to strike (CDC, 2008). However, it is hoped that with better interventions and preparedness planning the overall mortality will be less than those witnessed in past pandemics (Morens & Fauci, 2007).

Current Preparedness Plans

Because of the immense scope of a pandemic, the CDC assumes an AI pandemic will overwhelm existing healthcare capacities in the U.S. and result in a large number of deaths. The WHO warns that the next AI pandemic, in the best case scenario, could cause between 2 to 7 million deaths worldwide, and greater than 10 million hospitalizations in intensive care units.(McFee, 2007) As a result the CDC has stated a number of assumptions in case of an AIV pandemic. Firstly, the responsibility for the domestic response will be with the State, Local, Territorial and Tribal Governments (SLTT), which includes local business, healthcare, community, and faith-based organizations (CDC, 2005). In addition, there will be an increase in disruptions of healthcare and safety because of public anxiety that will cause increased psychogenic and stress-related illness and greater stress on hospitals and emergency departments (CDC, 2008). The current preparedness plans assume that local governments will create proper plans to deal with an AIV pandemic. It is also assumed that these plans will be disseminated to physicians that will be in contact with patients that have AIV infections.

To contain possible pandemic, antiviral drugs will be stored in the U.S. and internationally, and an emphasis will be placed on non-pharmaceutical and pharmaceutical interventions to reduce continued spread (CDC, 2005).

The CDC has made a number of non-pharmaceutical recommendations in preventing spread of Avian Influenza (United States Department of Health & Human Services, 2007). These include the importance to wash hands with soap and water, or use alcohol-based hand cleaner if soap not available. Covering the mouth and nose with a tissue when you cough or sneeze, and voluntary avoidance of ill people and crowds by home quarantine will be important. Wearing an N-95 respirator or higher filtering facemask. Regular facemasks do not prevent inhaling microscopic particles and were shown to be ineffective in preventing spread of the 1918-1919 pandemic (CDC, 2008)(PC Gruber et al., 2006). The public should commence with domestic cleaning and sanitizing during an outbreak. Also, citizens should begin self monitoring for symptom development (CDC, 2005).

Proper planning will be especially important in intensive care units (ICU). Patient and healthcare worker protection and quarantine will be necessary during a pandemic(PC Gruber et al., 2006). Also, proper stockpiling of ventilators will be necessary. A ventilator capable of accurately measuring tidal volume, plateau pressure and intrinsic positive end-expiratory pressure will be ideal for ventilators used during an AIV pandemic (PC Gruber et al., 2006). The management of the sequelae of AIV infections includes ventilator support for respiratory failure. Ventilator support is usually necessary after 48 hours post admission, and intensive care for multiorgan failure is often necessary (J. H. Beigel et al., 2005)(PC Gruber et al., 2006). Sixty-three percent of infected patients require advance organ support, and of these 68% develop multiorgan failure. At least 54% develop acute respiratory distress syndrome and 90% of these people die (PC Gruber et al., 2006) The stockpiling of necessary medications to treat end organ damage, such as corticosteroids, antivirals, and antibiotic medications will be necessary (J. H. Beigel et al., 2005).

In addition, complications of interventions should be planned for in advance. These include ventilator-associated pneumonia, pulmonary hemorrhage, pneumothorax, pancytopenia, Reye's syndrome, and sepsis syndrome without documented bacteremia (J. H. Beigel et al., 2005). Research efforts during a pandemic will be important in the development of vaccines and medical treatments to reduce the effects of an AIV pandemic (CDC, 2005). Current efforts into the study of the AI virus (H5N1), has been hampered by country sovereignty issues, most recently an argument between Indonesia and the WHO, in which the WHO is refusing to return samples provided because Indonesia does not have the necessary safety standards in their labs. As a result the Indonesian government has slowed its submission of samples to the WHO (Enserink & Normile, 2007). In addition, foreign countries argue that the vaccines produced in Western countries will economically benefit and exclude them from these benefits (Garrett & Fidler, 2007).

Surveillance in wild bird populations has been the main focus to monitor the virulence of avian influenza strains. The technique used for this is real-time RT-PCR. And while it has been proven effective in detecting H5 subtypes, it has recently been found ineffective at identifying H7 subtypes (Xing et al., 2008). Furthermore, the WHO has reported that factors important in study and surveillance of AIV cases will be the use of electronic records and the internet (WHO, 2007). These technologies may aid further research and better utilization of resources in case of an AIV pandemic by giving faster access to patient records by physicians and public health officials.

The role of osteopathic medicine in AIV pandemics has been a matter of discussion in pandemic preparedness planning. Retrospective observational data and case reports during the 1918-1919 pandemic showed a lower morbidity and mortality among patients treated by osteopathic physicians compared to allopathic physicians. Overall mortality was estimated to be 5 to 6%, however osteopathic physicians maintained a 0.25% mortality rate (Hruby & Hoffman, 2007)(McConnell, 2000). Since the predictors of preparedness proposed by the WHO and CDC are based on assumptions and best evidence available, the importance of osteopathic medicine cannot be ignored and thus should be considered in pandemic preparedness plans.

The techniques used during the 1918-1919 pandemic have been discussed and hypothesized for years. Most likely these techniques included a thoracic lymphatic pump technique, hepatic pump technique, splenic pump, abdominal lymphatic pump, pedal pump, and rib raising (Hruby & Hoffman, 2007)(Washington et al., 2003). These techniques are theorized to positively stimulate the immune system, and possibly avoid complications of influenza (Hruby & Hoffman, 2007).

Studies have shown the effects of osteopathic manipulation treatments. These effects included increased leukocyte count, increased destruction of red blood cells by spleen, increased immune response to vaccinations, increased basophil count which is important for initial immune response, prevention of atelectasis and increased lymphatic flow (Hruby & Hoffman, 2007)(Knott, Tune, Stoll, & Downey, 2005; Washington et al., 2003)(Sleszynski & Kelso, 1993)(Mesina et al., 1998). These effects could explain the effects on reducing mortality, first described after the 1918-1919 influenza pandemic.

Currently, 7 countries are thought to be in violation of the 1975 Biological and Toxin Weapons Convention (BTWC), which bans development, production, acquisition, and retention of biological weapons (Dudley & McFee, 2005). The creation of a biological weapon using AIV cannot be ruled out (McFee, 2007). As a result, the United States began the Strategic National Stockpile (SNS) in order to counteract this possible threat (CDC, 2008). Since its inception in 1999, the SNS is a repository for vaccines, antimicrobials, and medical response materials that can be sent, in case of a public health emergency, to any state within 12 hours (CDC, 2008). The states will then distribute these medical supplies. The SNS will be relied upon in case of an influenza pandemic.

Patient knowledge and education was mentioned as an important factor in physician preparedness planning (CDC, 2005). However, a survey administered to patients in 2006 at an Internal Medicine clinic showed that the average percentage of correct answers in regard to knowledge of AIV was 49% (Gaglia, Cook, Kraemer, & Rothberg, 2008). Two percent of responders answered all the questions correctly, with only 7% of respondents aware that antiviral medications were effective against AIV (Gaglia et al., 2008). Most respondents were willing to wear a mask or be quarantined, but less supportive of mandated vaccinations and therapies (Gaglia et al., 2008). Only 22% believed that the government would be able to contain infections of AIV (Gaglia et al., 2008). Forty two percent were worried about an AIV pandemic (Gaglia et al., 2008). And unfortunately, healthcare professionals were not found to be significant sources of patient information about AIV (Gaglia et al., 2008).

Finally, the ethical and legal treatment of patients was of utmost importance. The CDC has warned that quarantining efforts are important for prevention of spread of disease; however, the ethical and legal issues in mandatory vaccination and quarantine are difficult to predict. The CDC recommends leaders and physicians to refrain from harming or injuring individuals and communities during a pandemic. There should be equal opportunity to access of resources. Respect for autonomy by using least restrictive interventions should be developed and used. Ideally, these interventions should be voluntary, unless the safety of the person or community is at risk. Also an appeals process should be developed in the community (CDC, 2008).

Physician Preparedness

Preparedness plans for avian influenza pandemics require physicians to play an important role. Physicians need to participate in preparedness exercises, and they should become more familiar with the preparedness efforts in their community. In addition, calls for more education and training of physicians have been made to better their ability to respond appropriately (Dudley & McFee, 2005). These suggestions include continuing medical education courses on preparedness, rationed health care, triage medicine, biological weapons, state and national legislation and planning, patient preparedness, and education (Dudley & McFee, 2005).

The CDC has made specific recommendations to help physicians and healthcare facilities deal with a potential severe acute respiratory syndrome in

2004 (CDC, 2005). These recommendations on areas of preparedness have been used in preparedness planning for an avian influenza pandemic. These areas include prevention, infection control precautions (masks and proper hand washing), proper quarantine of patients, rapid communication between healthcare facilities and departments, laboratory requirements, legal authority, surveillance, reporting of cases, evaluation and diagnosis (CDC, 2005).

Although priority has been placed on prepared physicians, disturbing results of recent surveys show that physicians are not confident in plans currently provided by government agencies. They report that they still require further education, guidance, resources, and interventions to deal with an AIV pandemic (American Public Health Association, 2008)(Business Wire, 2005)(Beaumont et al., 2007)(Cole, 2006). A majority of physicians believe that the medical community requires increased preparation and they are skeptical that antivirals and vaccines will be available in sufficient supply to alleviate an avian influenza pandemic (American Public Health Association, 2008)(Business Wire, 2005). A significant number of physicians are unable to explain avian influenza to their patients (Beaumont et al., 2007).

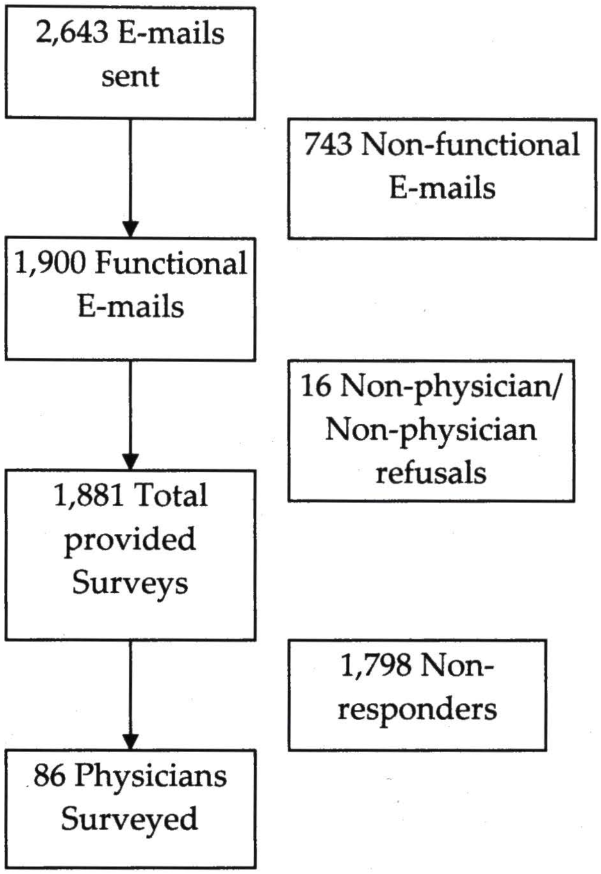
The fact that a priority has been placed on physician preparedness, and that physicians still feel unprepared, has illustrated that more work must be done. There is no current study that has investigated the perceptions of physicians on AIV preparedness. Such knowledge would provide insight into possible barriers to physician preparedness and ultimately assist in AIV preparedness planning.

CHAPTER THREE

METHODS

Data was collected from an electronic mail survey sent to a total of 1,881 recipients on an academic research journal E-mail list for 1 week from February 26th to March 5th, 2008. The population represented in the E-mail database was unknown to the researchers; therefore, the survey was sent to all E-mail addresses in the available database. The recipients were encouraged to indicate by E-mail if they were not physicians or did not wish to participate in the survey. The survey was designed and applied through the UltimateSurvey software©. The software blocked incomplete survey responses and instructed the subject to finish the incomplete portion before submission. Those E-mail addresses that were not deliverable were removed from the total number of subjects surveyed. If the subject identified themselves as not being a physician (n=16), they were removed from the total number of subjects surveyed. Seven hundred fifty-nine surveys were undeliverable, leaving 1,881 physicians as the study population for this study, which included those physicians that refused (n=3) (Figure 1).

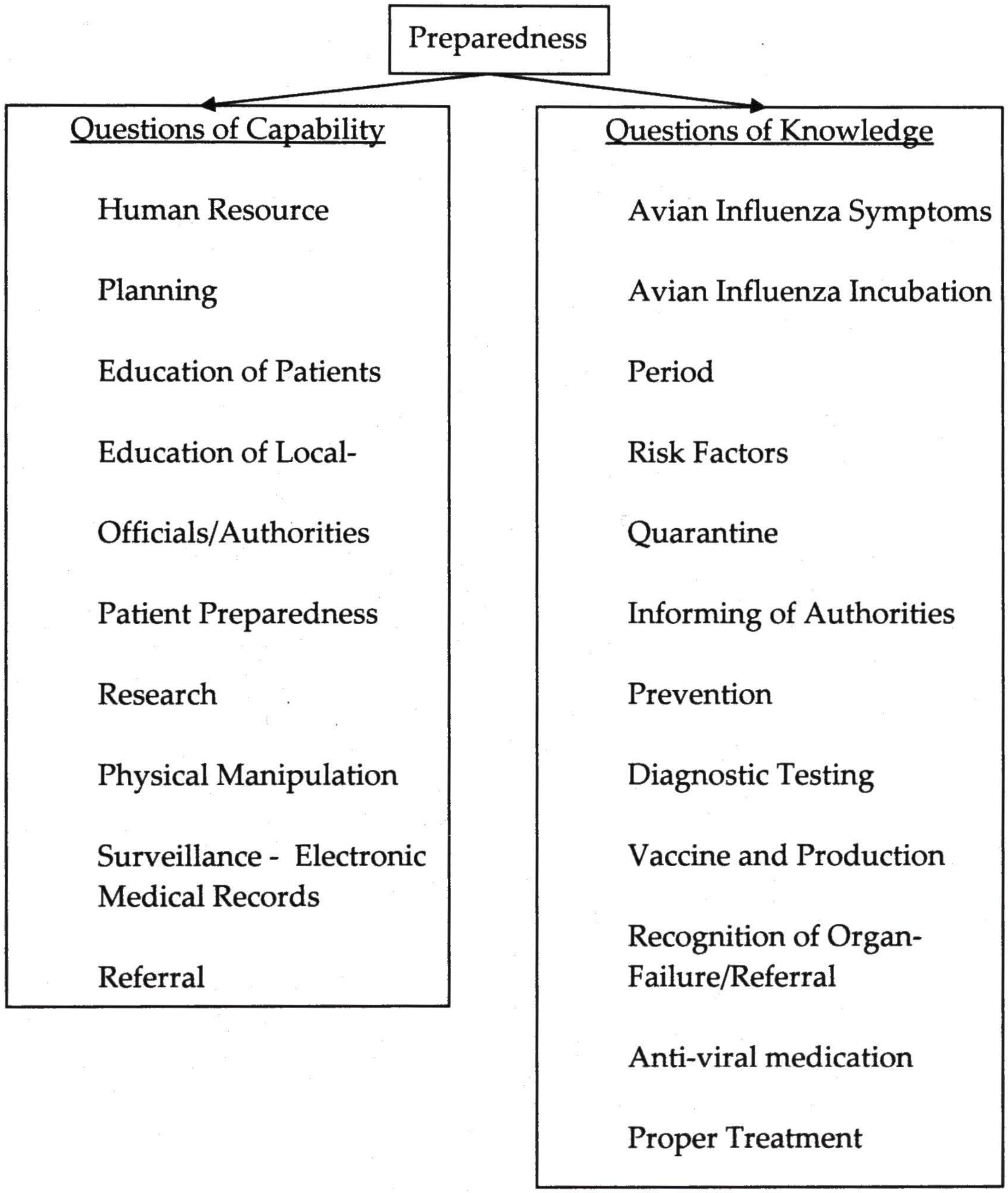
Figure 1 **Surveys sent by E-mail and the number of responses.**



The survey tool was developed after a Pub Med search using avian influenza, preparedness, plans, physician and predictors as key words. All U.S. government (CDC and HHS) and international plans (WHO) were reviewed. The bulk of the survey questions were developed after reviewing the recommendations for preparedness, explained in the WHO, HHS and CDC, in the event of an avian influenza pandemic threat or other community health risks (CDC, 2005; CDC, 2008; United States Department of Health & Human Services, 2007; WHO, 2005). The structure of the survey was based on questionnaires retrieved from the Centers of Disease Control and Prevention (CDC, 2005). When validated questions could not be found, questions were constructed using the best available literature on what was known about the predictors of preparedness (Appendix A).

The questionnaire had 41 total questions, which included demographic questions (9 items), physician's recommendations on importance of predictors of preparedness (13 items), and questions testing the respondents' current preparedness capability (8 items) and knowledge (11 items) (Figure 2) (Appendix A). Since there was no proven algorithm for combining knowledge and capacity, the results of these questions were combined based on the definition of preparedness which relies on both knowledge and capability of implementing recommended predictors. The capability and knowledge questions were scored, either one point for correct answer on knowledge questions, or one point for whether the physician had a capability, and these scores were summed then divided into quartiles. A passing score was defined to be in the upper quartile. Those physicians that were placed in the 75th or higher group will be referred to as prepared. The other physicians were referred to as not prepared. The physician's importance responses were measured on a 10-point Likert scale (1 through 10) for 13 predictors of preparedness.

Figure 2 **Preparedness based on two constructs and the question topics asked on the preparedness test.**



The demographic questions were chosen as predictors of possible inherent differences between physicians. Age was considered a predictor because it was assumed that as a physician aged, knowledge or capability of the physician may change. In addition, length of practice was considered. The importance of length of practice could be evaluated by using age; however, the length of practice predictor was separated from age because it asked about actual time in practice.

Race was considered as a possible predictor to describe possible differences in physician responses related to social or ethnic influences. Gender was chosen as a predictor in an attempt to delineate differences between male and female physicians' self perception of preparedness. Medical degree was included to determine if the difference in training experiences between DO and MD physicians indicated better preparedness. Whether the physician had an additional graduate degree was considered because it may indicate a difference in motivation between practitioners, or how a physician may approach a problem. The specialty of the physician could result in a difference between prepared and unprepared physicians. Because subspecialists have a narrow scope in their practice, it was hypothesized that a subspecialist may be at a disadvantage when attempting to diagnose a patient with a disease outside of their interest. Type of institution was important because physicians that work in academic institutions may be forced to deal with current medicine trends more completely so they can publish and educate. Finally, the population of practice was included to determine if a practitioner in a small community may need to be more prepared than those in a metropolitan setting. In addition, the variety and complexity of pathology witnessed by physicians in the two different populations may differ.

The physician opinions on importance of predictors were based on international and U.S. recommendations for AIV pandemic preparedness that applied to physicians. The opinion questions included human resources plans, diagnostic capability, patient education, human and animal infection surveillance, rationing, quarantine, internet access, electronic records, recognition of organ failure and referral, medical treatment, government plan knowledge, virus knowledge, personal protection and prevention, and physical manipulation.

Due to the small number of respondents, the demographic variables of race, population served, type of institution, and subspecialty were recoded. Race was recoded into white versus non-white responders. The definition of metropolitan communities from the Federal Office of Management and Budget was used to justify categorization of the population served into two subcategories (less than 20,000, and greater than or equal to 20,000 people). Type of institution was recoded into whether the physician worked in an academic institution or not. Physicians were asked to give their specific subspecialty, if applicable. This variable was recoded into whether they had a self-reported specialty or if they were a general internal medicine, family medicine, or other general practitioner. The specific other degree variable was removed from evaluation due to the small number of respondents and multiple subcategories that resulted. The data was analyzed using SPSS Version 15.0 (SPSS Institute, Chicago, IL).

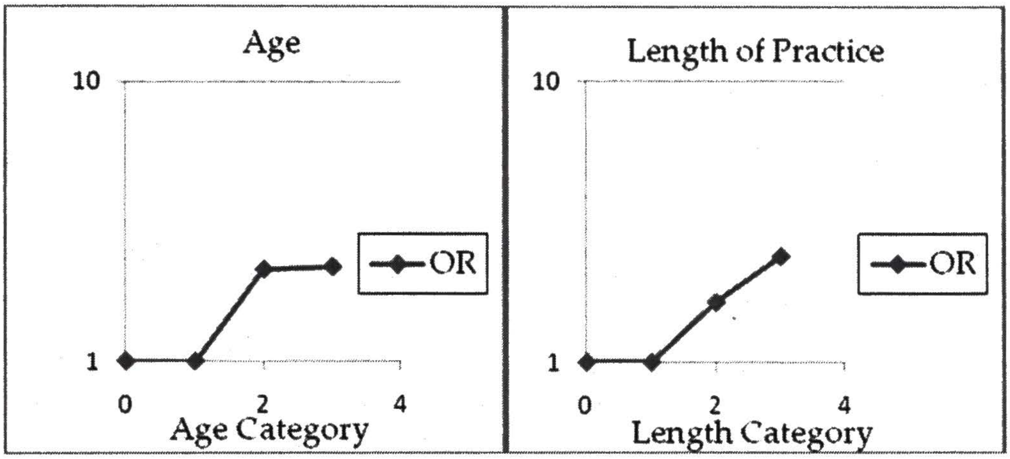
Bivariate analyses were performed initially. Then univariate and multivariable logistic regression analyses, using physician's preparedness status as the dependent variable, were conducted. The variables tested included: age, gender, race (white or non-white), generalist versus specialist physicians, physicians working in academic versus non-academic institutions, the population served less than 20,000 people versus greater than or equal to 20,000 people (population served), length of practice (length of practice), physician's medical degree (MD or DO), whether the physician has an additional graduate degree (Other Degree) and the 13 Likert scale responses to assess the importance of each predictor of preparedness (Appendix A).

Bivariate analyses were performed on all possible predictors to determine if there was any difference between means and within the variable groups. Chi-squared analysis was performed for categorical variables. Data that was collected on a continuous scale was evaluated using the student t-test.

Unconditional logistic regression was used to calculate odds ratios (OR) and 95% confidence intervals (95% CI) comparing each independent predictor of preparedness separately among prepared and unprepared physicians. A final model was constructed utilizing all significant predictors in a backward selection procedure using goodness-of-fit tests (α=0.10) to find the most parsimonious model. In addition, the degree variable was considered a possible confounding variable and, therefore, included in the multivariable analysis. Confounders were defined as covariates that changed the estimated exposure OR by greater than 10% when removed from the model.

Continuous variables including length of practice and age were tested for linearity in the logit. The age and length of practice variables were recoded into four indicator variables using the 10^{th}, 25^{th}, 50^{th} percentiles, as the break points (iage1, iage2, iage3, iage4, iLofP1, iLofP2, iLofP3, iLofP4). The indicator variables were evaluated in a logistic regression model using the prepared status as the dependent variable. The OR of each indicator variable was charted on a scatter plot using a logarithmic scale (Figure 3).

***Figure* 3 Linearity of continuous variables age and length of practice on a logarithmic scale**



OR=Odds ratio, Age Category=categorical variables of age, Length Category=categorical variables of length of practice.

The lack of linearity of the continuous age variable resulted in the recoding of the age variable into a categorical variable. Due to small numbers of responses, the age variable was recoded into a dichotomous variable, either below or above and equal to 53 years, which was the 50th percentile for age. A complete multivariable logistic regression analysis was performed and changes in ORs and 95%CIs were reported.

There was also a concern that the physical manipulation predictor could be an effect measure modifier in DO's, but not MD's, due to a possible difference in training and knowledge. Therefore, the relationship between medical degree and physical manipulation was tested using cross product terms (manipulation*MD/DO degree). The joint effect of manipulation and degree was evaluated on the multiplicative scale using the likelihood ratio test (α=0.20) where we compared the observed OR to the joint effect for the double exposed (performed manipulation and DO) to the expected joint odds ratio.

CHAPTER FOUR

RESULTS

The cross sectional survey received 86 responses, with a response rate of 5 percent. Twenty-four physicians were categorized as "prepared." The prepared physicians tended to be older with a mean age of 55.3 years old, compared to 51.1 years old in the non-prepared group (Table 2). The mean practice length of responders was 23.9 years in the prepared group, in contrast to the 19.2 years in the non-prepared group. Most respondents were males at 76 percent. The ethnicity of respondents included 87% white/Caucasian. Thirty eight of the responders were MD's, and 48 were DO's. There were 67 generalists and 19 specialists. Thirty six percent of the physicians reported some other graduate degree in addition to their medical degree. Fifty-seven percent of the physicians described their practice in an academic setting and 79% described it in a metropolitan area. The students t-test and chi-square analysis, found statistically significant differences between prepared and non-prepared physicians in age, p=.02, length of practice, p=.03, and importance of physical manipulation treatment, p=.03 (Table 2,3).

Table 2 Study population characteristics

Population Characteristics		Prepared (n=24)		Not Prepared (n=62)		t-test
		Mean	SD	Mean	SD	*p* value
Age		55.25	5.07	51.05	8.22	.022
L of P		23.88	7.46	19.16	9.27	.029
		n	%	*n*	%	
Gender	Male*	21	87.5	44	71.0	.162 **
	Female	3	12.5	18	29.0	
Ethnicity/Race	White*	21	87.5	54	84.4	1.000 **
	Other	3	12.5	8	15.6	
Medical Degree	MD*	7	29.2	31	50.0	.081
	DO	17	70.8	31	50.0	
Other degree	Yes*	9	37.5	22	35.5	1.000
	No	15	62.5	40	64.5	
Practice	General*	19	62.5	48	77.4	.861
	Specialist	5	37.5	14	22.6	
Institution	Non-academic*	12	50.0	25	40.3	.416
	Academic	12	50.0	37	59.7	
Pop. served	Non-metro*	4	16.7	14	22.6	.769 **
	Metro	20	83.3	48	77.4	

Physician response dichotomous variables. Chi-square analyses used to determine *p* values. MD=medical doctor, DO=doctor of osteopathy, Metro=metropolitan, %=percent, LofP=length of practice, Pop=population. *=referent group, **=Fischer's Exact Test used.

Table 3 Distribution of physician responses to opinion questions measured on the Likert scale

	Prepared (n=24)		Not Prepared (n=62)		
Opinion questions†	Mean	SD	Mean	SD	*t-test* *p* value
HR management	7.21	2.80	6.98	2.76	.737
Diagnostics	6.88	2.86	7.40	2.72	.428
Veterinarian relationship	5.21	2.70	5.03	3.11	.808
Patient education	8.58	2.38	7.69	2.38	.123
Rationing	6.75	2.80	6.90	2.58	.81
Quarantine	7.42	2.93	7.48	2.57	.917
Internet access	6.46	2.64	6.90	2.29	.441
Electronic records	5.88	3.22	5.02	2.62	.204
Pulmonologist	6.79	2.84	6.60	2.61	.763
Antiviral/vaccine	7.54	3.11	7.87	2.79	.636
L/S/F plans	7.88	2.29	7.55	2.52	.582
AIV knowledge	8.42	2.23	7.81	2.37	.28
Personal protection	9.00	1.72	8.92	2.16	.87
Physical manipulation	5.75	3.25	4.16	2.90	.03

†= 10 point Likert scale where 1=least important and 10=most important
SD=standard deviation, HR=human resources, L/S/F=local/state/federal, AIV=avian influenza virus.

In addition, the use of physical manipulation in practice significantly differed between preparedness groups in descriptive and bivariate statistics. Other predictors tested were not found to be significant.

Logistic regression analysis found some differences between the preparedness groups (Table 4). Prepared physicians tended to be older, OR=1.08,95%CI 1.009-1.164, in practice longer, OR=1.06,95%CI 1.005-1.127, and tended to feel physical manipulation was more important, OR=1.19,95%CI 1.01-

1.40. A trend, defined as *p* values less than .1, showed MD's were more prepared, OR=0.41, 95%CI=0.15-1.13, *p* value=.085.

Table 4 Crude odds ratios and 95% confidence intervals from logistic regressions of physician preparedness on predictors of preparedness

Variables	OR	95% CI	*p* value
Age*	1.08	1.010-1.16	.028
Length of Practice*	1.06	1.01-1.13	.033
Gender			
Male	1.00		
Female	2.86	0.76-10.81	.121
Race/Ethnicity			
White	1.00		
Black	1.04	0.25-4.29	.96
Degree			
MD	1.00		
DO	0.41	0.15-1.13	.085
Other Degree			
Yes	1.00		
No	1.09	0.41-2.90	.861
Specialty			
Generalist	1.00		
Specialist	0.90	0.29-2.85	.861
Type of Institution			
Non-academic	1.00		
Academic	0.68	0.26-1.74	.417
Population of Practice Served			
Non-metropolitan	1.00		
Metropolitan	1.46	0.43-4.98	.547
Opinion questions†			
HR Management	1.03	0.87-1.23	.733
Diagnostics	0.93	0.79-1.11	.424
Veterinarian Relationship	1.02	0.87-1.20	.805
Patient Education	1.21	0.95-1.55	.131
Rationing	0.98	0.82-1.17	.808

Quarantine	0.99	0.83-1.18	.916
Internet Access	0.92	0.76-1.13	.436
Electronic Records	1.12	0.94-1.33	.204
Pulmonologist	1.03	0.86-1.23	.76
Antivirals/Vaccines	0.96	0.82-1.13	.631
Local/State/Federal Plans	1.06	0.87-1.29	.578
Virus Knowledge	1.14	0.90-1.43	.281
Personal Protection	1.02	0.80-1.30	.869
Physical Manipulation	1.19	1.01-1.40	.034

*=continuous variable, †= 10 point Likert scale where 1=least important and 10=most important
SD=standard deviation, HR=human resources, L/S/F=local/state/federal, AIV=avian influenza virus.

The other Likert scale physician opinion variables were not found to be significant. Other demographic predictors, including medical degree, gender, race, other degree, specialty, institution type, and population served, were not found to be statistically significant.

The full multivariable regression model was performed twice, with two forms of the age variable and the OR and 95% confidence intervals were evaluated (Appendix B). The results of these regression analyses were determined to show no notable differences. Of note is the importance of government plans predictor's 95% CI shifted to the right, which caused no difference between the preparedness groups, OR=0.56, 95%CI=0.308-1.009. Also, gender's 95%CI narrowed, and shifted to the left, and resulted in an insignificant factor, OR=0.04, 95%CI=0.966-331.44. All other predictors maintained statistical significance between the two models.

The most parsimonious model was attempted using *p* values below .45 in the full multivariable regression models, and *p* values below .25 in the logistic regression analyses to eliminate predictor variables. The results were limited by the response rate and the number of predictors in the model. Also, the research question dealt with all predictors of preparedness to find how these influenced preparedness of physicians. Ultimately, the most parsimonious model was found using *p* values under 0.25 on logistic regression analyses and without length of practice because of a probable collinear association with age (Appendix C).

Factor analysis was attempted, using medical degree as an effect measure modifier in the relationship between physical manipulation and preparedness (Appendix D). Unfortunately, the results were found to be limited by the response rate and the number of predictors in the model. The effect measure modifier analysis was not significant or reliable, and could not answer whether this difference was based on a relationship between medical degree and importance of physical manipulation which provided an enhancement of preparedness. Although the results were not particularly meaningful, the experience was important in developing further statistical skill sets for future studies.

To see if there was a difference in the importance of physical manipulation in predicting performance on the preparedness test depending on the medical degree and training, the regression models were stratified into two groups including MD or DO physicians (Appendix E). However, the stratified models showed no significant results.

The full multivariable model, including all 22 predictors, showed that for every 1 point increase in the importance of patient education, electronic records, and physical manipulation, there was an 2.9, 2.0, and 1.6 increase in odds, respectively, of being prepared (Table 5). However, with every 1 point increase in the importance of diagnostic testing, internet access, and knowledge of local, state and federal plans there was a 0.6, 0.4, and 0.5 decrease in odds of being prepared respectively.

Trends in the multivariable regression analysis, where *p* values were less than .1 but not significant, were found for age (OR=1.22, 95%CI=0.99-1.49, *p* value .063) and physicians that reported a subspecialty (OR=11.39, 0.64-201.97, *p* value=.097). Physicians that served metropolitan areas were less likely to be prepared, OR=0.06, 95%CI=0.01-1.61, *p* value=.094. For every 1 point increase in the importance of virus knowledge there was a 1.8 increase in odds of being prepared (Table 5).

Table 5 Multivariable logistic regression model analyses using predictor variables versus physician preparedness

Variables	OR	95% CI	*p* value
Age*	1.22	0.99-1.49	.063
Length of Practice*	0.99	0.86-1.14	.909
Gender			
Male	1.00		.040
Female	29.46	1.17-740.54	
Race/Ethnicity			
White	1.00		
Non-white	0.10	0.01-1.57	.101
Degree			
MD	1.00		
DO	0.20	0.01-3.14	.249
Other Degree			
Yes	1.00		
No	0.20	0.02-1.84	.153
Specialty			
Generalist	1.00		
Specialist	11.39	0.64-201.97	.097
Type of Institution			
Non-Academic	1.00		
Academic	0.70	0.11-4.47	.704
Population of Practice Served			
Non-Metropolitan	1.00		
Metropolitan	0.06	0.01-1.61	.094
Opinion questions†			
HR Management	1.33	0.92-1.93	.130
Diagnostics	0.55	0.34-0.89	.015
Veterinarian Relationship	1.19	0.75-1.89	.474
Patient Education	2.94	1.40-6.16	.004
Rationing	0.98	0.66-1.48	.936
Quarantine	0.91	0.52-1.58	.739
Internet Access	0.42	0.22-0.78	.006
Electronic Records	1.99	1.12-3.51	.018

Pulmonologist	0.93	0.58-1.50	.761
Antivirals/Vaccines	0.71	0.45-1.10	.126
L/S/F Plans	0.49	0.25-0.97	.042
Virus Knowledge	1.83	0.97-3.45	.064
Personal Protection	1.16	0.52-2.59	.714
Physical Manipulation	1.58	1.02-2.43	.040

All predictor variables were analyzed versus physician preparedness status *=continuous variable. †= variable on Likert scale of 1 to 10. OR=odds ratio, 95% CI=95% confidence interval.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

The role of physicians will be important in an eventual AIV pandemic and will be relied upon by their patients and their communities to prevent the unnecessary loss of lives (CDC, 2005). However, the preparedness of physicians remains poor and the physicians themselves have reported that they believe the response to pandemic influenza is insufficient (American Public Health Association, 2008)(Business Wire, 2005)(Beaumont et al., 2007)(Cole, 2006). As a result, physicians have requested more education, guidance, resources, and interventions to combat avian influenza.

Understandably, unprepared physicians have resulted in other preparedness planning efforts being hindered. The education of patients is still poor and their concern for an AIV pandemic is significant (42% of patients surveyed) (Gaglia et al., 2008). Local planning efforts rely, partly, on knowledgeable physicians to provide insight in proper implementation of federal and international recommendations (CDC, 2005).

Physicians remain unprepared, although they have received advanced warning and significant resources in planning for an AIV pandemic. The factors influencing perceptions of physicians on AIV pandemic planning have never been tested and may be an explanation for the continued unpreparedness of physicians.

Because perceptions are not entirely based on the predictors of preparedness as defined by federal and international agencies, other demographic data were used as factors in the preparedness models. Interestingly, male gender showed a greater increase in the likelihood of being in the prepared group. The reason for this is thought provoking, and ultimately could be related to a number of explanations. Effects of gender on perceptions of preparedness could include how physicians of opposite gender approach problems, different opportunities afforded to each gender in training and practice, the limitations placed on genders either intentional or unintentional, or their role in the family. Another explanation could be a statistical anomaly due to small number of data points and a large number of factors tested in the multivariable logistic regression model. This explanation seems more likely due to the large OR in comparison with other OR's, and the wide 95% confidence interval indicating unstable data.

Positive response to the importance of patient education, use of electronic records, and physical manipulation were all shown to have an increase in the likelihood of being prepared. These areas deal with preparedness factors including education, surveillance and osteopathic treatment, respectively, that are important preparedness goals (Hruby & Hoffman, 2007)(McConnell, 2000)(CDC,2005)(Gaglia et al., 2008). All three of these predictors dealt with capability areas for preparedness. Possibly this could be related to the character of the physician to be proactive in their practice to deal with pandemic avian influenza.

Education of patients about their health and preparedness planning was found to be an important factor for physicians' own preparedness. From previous surveys of patients it is known that most physicians have to improve their education efforts to patients (Gaglia et al., 2008). In doing so, the physician's own knowledge and preparedness may improve. These efforts can include providing information on AIV symptoms, voluntary quarantine, and prevention.

Electronic medical records will be important for surveillance, research and efficient treatment of patients who are suspected of AIV infection (WHO, 2005). The use of this technology may allow physicians the opportunity to affect a number of areas of preparedness planning efforts and by doing so, provide better prepared physicians.

Physician preparedness and the importance of the capability of osteopathic manipulative treatment are related. The use of osteopathic techniques was reported to improve mortality and morbidity in patients of past pandemics (Hruby & Hoffman, 2007). Current available research shows that osteopathic manipulation increases immune response to vaccines, leukocyte counts and lymphatic flow (Hruby & Hoffman, 2007)(Knott, Tune, Stoll, & Downey, 2005; Washington et al., 2003)(Sleszynski & Kelso, 1993)(Mesina et al., 1998). However, other explanations, such as the type of populations served, urban versus rural, and greater focus of prevention by DO's should be evaluated in future research.

If manipulation therapy does have an effect on avian influenza morbidity and mortality, this may also affect a number of preparedness factors including rationing of treatments, proper referral, and evaluation of respiratory and other end organ dysfunctions (Hayden, 2006; Nap, Andriessen, Meessen, & van der Werf, 2007; Nettleton & Self, 2007; PC Gruber et al., 2006; Schunemann et al., 2007; Sleszynski & Kelso, 1993). By treating these conditions with osteopathic manipulation, in the office or hospital setting, it may increase the availability of pandemic recourses for hospitals and patients.

Factors of internet access, diagnostic testing, and knowledge of local, state, and federal pandemic plans were significant for reduced likelihood of being prepared. Although importance of internet access deals with a capability construct, it may also indicate a lack of perceived knowledge in the particular physician. The importance of internet access could therefore be a possible indicator of the confidence of the physician to deal with disease and patient care in avian influenza pandemics. The importance of diagnostic testing in preparedness planning is important in not only disease detection, but also in future research and surveillance (CDC, 2005)(WHO, 2008). However, it appears that physicians who perceive diagnostic testing to be important have a reduced likelihood of being prepared. In regards to the importance of local, state and federal plans, surveys have shown that physicians lack confidence in government plans to deal with the avian influenza pandemic (American Public Health Association, 2008)(Business Wire, 2005)(Beaumont et al., 2007)(Cole, 2006). This may indicate that those in the lower performing group are simply relying more on the government to provide aid and guidance in case of a pandemic. Whereas the physicians that are prepared have a more proactive approach to preparedness and do not fully depend on other agencies, but develop their own preparedness plans. It is also a possibility that capability may be an evolution from strictly knowledge, to the actual application of knowledge (capability).

The results of this study have shown that the perception of preparedness may affect the ability of a physician to be prepared. This begins with their knowledge and capacity in regards to the avian influenza pandemic plans. The importance of knowledge and capability of implementing preparedness plans are necessary for prepared physicians. The simplification of the construct and factors used in evaluating preparedness was necessary due to the expected response rate and the exploratory nature of the research study, but also allowed for evaluation of preparedness that had not been attempted before.

Further evaluation of the perception of preparedness in physicians should be performed to better understand the relationship with predictors. It may be that physicians who tend to emphasize the capability of responding are more likely to be prepared. An expanded survey tool should be developed and validated to better evaluate the relationship between knowledge and capacity in perception of preparedness. The attitudes, beliefs and practice activities of physicians should be evaluated. Some of these areas include the fear level of physicians, and whether physicians have attended past seminars or training for avian influenza pandemic preparedness.

The essential predictors of preparedness remain elusive, and ultimately may not be fully explained until after an avian influenza pandemic affects the 21st century, if at all. Therefore, the current efforts at survey analysis of physician preparedness may be ineffective and insufficient to properly understand preparedness. However, the importance of defining current recommended predictors in terms of capability and knowledge, and the perceptions of physicians is research that has not been previously performed, in no small part to the overwhelming subject matter, and ever changing available medical evidence. To change the focus of preparedness research from strictly knowledge-based to measures of capability and action may suggest methods for better preparation of physicians.

APPENDIX

A. Avian Influenza Survey Construct

Construct	Reference	# Q
Questions on Preparedness Level (19)	1. World Health Organization (WHO). *Responding to the avian influenza pandemic threat.* Communicable Disease Surveillance and Response Global Influenza Programme, August 2005. http://www.who.int/csr/disease/avian_influenza/avian_faqs/en/index.html#strategy2 2. U.S. Department of Health and Human Services *State and Local Pandemic Influenza Planning Checklist.* December 2, 2005. 3. Centers for Disease Control and Prevention (CDC). *Updated Interim Guidance for Laboratory Testing of Persons with Suspected Infection with Avian Influenza A (H5N1) Virus in the United States.* Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, June 07, 2006. http://www2a.cdc.gov/han/ArchiveSys/ViewMsgV.asp?AlertNum=00246 4. Monto, AS. *The Threat of an Avian Influenza Pandemic.* New England Journal of Medicine. 352:323-325, January 27, 2005. 5. Centers for Disease Control and Prevention (CDC). *Key Facts About Avian Influenza A (H5N1) Virus.* Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, May 07, 2007. http://www.cdc.gov/flu/avian/gen-info/facts.htm. 6. World Health Organization (WHO). *WHO Rapid Advice Guidelines on pharmacological management of humans infected with avian influenza A (H5N1) virus.* April 2007. http://www.who.int/csr/disease/avian_influenza/	
1. Human Resource Planning [2]		1
2. Diagnostic Testing[5]		1
3. Education of Patients [2]		1
4. Education of Local Officials [2]		1
5. Patient Preparedness [5]		1
6. Avian Flu Incubation Period [7]		1
7. Recognition Symptoms/ Sequelae [5,10]		1
8. Risk Factors [4,8,9]		1
9. Legal Implications/ Quarantine [2]		1
10. Proper Informing of Authorities [2]		1
11. Prevention [2,6]		1
12. Research [1,2]		1
13. Physical Manipulation [11]		1

<table>
<tr><th>Construct</th><th>Reference</th><th># Q</th></tr>
<tr><td>14. Vaccine and Production [2,13,14,16]</td><td rowspan="6">guidelines/pharmamanagement/en/index.html
7. Yang Yang, ME Halloran, JD Sugimoto, IM Longini Jr. Detecting Human-to-Human Transmission of Avian Influenza A (H5N1). Emerging Infectious Diseases 13,9. September 2007.
8. Taubenberger JK, AH Reid, RM Lourens, R Wang, G Jin, TG Fanning. Characterization of the 1918 influenza virus polymerase genes. Nature 437, 889-893. 6 October 2005.
9. Centers for Disease Control and Prevention (CDC). What age groups are most likely to be affected during an influenza pandemic? Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, January 2008. http://www.pandemicflu.gov/faq/pandemicinfluenza/1080.html
10. World Health Organization (WHO). Avian influenza-epidemiology of human H5N1 cases reported to WHO. Weekly epidemiological record. 81, 249-260. 30 June 2006. http://www.who.int/wer
11. Hruby RJ, KN Hoffman. Avian influenza: an osteopathic component to treatment. Osteopathic medicine and Primary Care. 1:10. 9 July 2007.
12. Centers for Disease Control and Prevention (CDC). Prevention and Control of Influenza: Recommendations of the Advisory Committee on Immunization Practices. Influenza Division, National Center for Immunization and Respiratory Diseases. 56(RR06);1-54. 13 July 2007. http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5606a1.htm
13. Luke CJ, K Subbarao. Vaccines for Pandemic Influenza. Emerg Infect Dis. 2006 Jan. http://www.cdc.gov/ncidod/EID/vol12no01/05-1147.htm.
14. Normile D. Avian Influenza: Flu Virus Research Yields Results but No Magic Bullet for Pandemic. Science 319;5867:1178-1179. 29 February 2008.
15. Kanter, RK. Strategies to improve pediatric disaster surge response: Potentially mortality reduction and tradeoffs. Critical Care Medicine. 35(12):2837-2842, December 2007.</td><td>1</td></tr>
<tr><td>15. Recognition of Respiratory Failure and ER referral [2, 14, 15]</td><td>1</td></tr>
<tr><td>16. Electronic Medical Records</td><td>1</td></tr>
<tr><td>17. Pharmacology of Anti-viral medications [6,12]</td><td>1</td></tr>
<tr><td>18. Proper Treatment [2,5,6]</td><td>1</td></tr>
<tr><td>19. Pulmonology Referral [5]</td><td>1</td></tr>
</table>

Construct	Reference	# Q
	16. McFee, RB. *Avian Influenza: The Next Pandemic?* Dis Mon 53:348-387, 2007.	
Likert Scale Questions: Importance of Predictors for Preparedness (13)		
21. Human Resource Planning	1. Centers for Disease Control and Prevention (CDC). *Key Facts About Avian Influenza A (H5N1) Virus.* Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, May 07, 2007. http://www.cdc.gov/flu/avian/gen-info/facts.htm. 2. Centers for Disease Control and Prevention (CDC). *Updated Interim Guidance for Laboratory Testing of Persons with Suspected Infection with Avian Influenza A (H5N1) Virus in the United States.* Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, June 07, 2006. http://www2a.cdc.gov/han/ArchiveSys/ViewMsgV.asp?AlertNum=00246 3. World Health Organization (WHO). *WHO Rapid Advice Guidelines on pharmacological management of humans infected with avian influenza A (H5N1) virus.* April 2007. http://www.who.int/csr/disease/avian_influenza/guidelines/pharmamanagement/en/index.html 4. Centers for Disease Control and Prevention (CDC). *Prevention and Control of Influenza: Recommendations of the Advisory Committee on Immunization Practices.* Influenza Division, National Center for Immunization and Respiratory Diseases. 56(RR06);1-54. 13 July 2007. http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5606a1.htm	1
22. Diagnostic Testing		1
23. Veterinarian Relationships		1
24. Patient knowledge/education		1
25. Knowledge of virus natural course (Symptoms/Sequelae)		1
26. Rationing Prescriptions/Interventions		1
27. Local/State/Federal Pandemic Influenza Plan		1
28. Personal Protection		1
29. Physical Manipulation Treatment		1
30. Quarantine		1
31. Internet Access		1

Construct	Reference	# Q
32. Electronic Medical Records		1
33. Pulmonary Specialist Access		1
34. Antiviral/Vaccines		1
Demographics (9)	1. Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey Questionnaire.* Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2004 2. Centers for Disease Control and Prevention (CDC). *Ambulatory Health Care Data: Physician Induction Interview Form.* Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2007. http://www.cdc.gov/nchs/about/major/ahcd/surinst.htm #Survey%20Instrument%20NAMCS	1
1. Age [1]		1
2. Gender [1]		1
3. Race/Ethnicity [1]		1
4. Medical Degree [2]		1
5. Other Degree [2]		1
6. Length of Practice		1
7. Primary Specialty [2]		1
8. Subspecialty [2]		1
9. Practice Location (description)		1

The construct of the avian influenza survey tool. Construct variable topics listed in left column, Q=Question, Reference=the number corresponding to the footnote on the left column.

B. Multivariable logistic regression model analysis using predictor variables versus physician preparedness

Variables	OR	95% CI	*p* value
Age*	1.22	0.99-1.49	0.063
Age†	2.96	1.10-7.96	0.031
Length of Practice*	0.99	0.86-1.14	0.909
Gender†[a]	29.46	1.17-740.54	0.04
Race/Ethnicity†[b]	0.10	0.01-1.57	0.101
Degree†[c]	0.20	0.01-3.14	0.249
Other Degree†[d]	0.20	0.02-1.84	0.153
Specialty†[e]	11.39	0.64-201.97	0.097
Type of Institution†[f]	0.70	0.11-4.47	0.704
Population of Practice Served†[g]	0.06	0.01-1.61	0.094
HR Management‡	1.33	0.92-1.93	0.13
Diagnostics‡	0.55	0.34-0.89	0.015
Veterinarian Relationship‡	1.19	0.75-1.89	0.474
Patient Education‡	2.94	1.40-6.16	0.004
Rationing‡	0.98	0.66-1.48	0.936
Quarantine‡	0.91	0.52-1.58	0.739
Internet Access‡	0.42	0.22-0.78	0.006
Electronic Records‡	1.99	1.12-3.51	0.018
Pulmonologist‡	0.93	0.58-1.50	0.761
Antivirals/Vaccines‡	0.71	0.45-1.10	0.126
L/S/F Plans‡	0.49	0.25-0.97	0.042
Virus Knowledge‡	1.83	0.97-3.45	0.064
Personal Protection‡	1.16	0.52-2.59	0.714
Physical Manipulation‡	1.58	1.02-2.43	0.04

The age variable was evaluated as continuous and categorical variables. All predictor variables were analyzed versus physician preparedness status. [A]referent group male, [b]referent group white, [c]referent group MD, [d]referent group yes, [e]referent group general practice, [f]referent group non-academic, [g]referent group non-metropolitan. *=continuous variable. †=dichotomous variable ‡=variable on Likert scale of 1 to 10. OR=odds ratio, 95% CI=95% confidence interval, L/S/F=local/state/federal.

C. Multivariable logistic regression model using goodness of fit for best model.

Variable	*p* value**	95% CI	*p* value***	95% CI	*p* value****	95% CI	*p* value*****	95% CI
Age*	0.02	1.03 – 1.3	0.02	1.02 – 1.29	0.29	0.94 – 1.22	0.06	1.00 – 1.18
Gender†a	0.02	0.003 - .65	0.02	0.003 - .63	0.09	0.05 – 1.24	0.08	0.05 – 1.18
Degree†c	0.35	0.35 – 20.67	0.74	0.06 – 49.71	0.79	0.27 – 5.77	0.79	0.27 – 5.73
Patient Education‡	0.002	1.36 – 3.96	0.002	1.35 – 3.96	0.07	0.98 – 1.67	0.06	0.99 – 1.67
Electronic Records‡	0.002	1.29 – 3.01	0.002	1.30 – 3.01	0.12	0.96 – 1.44	0.12	0.96-1.44
Physical Manip‡	0.03	1.03 – 2.10	0.33	0.73 – 2.52	0.11	0.96 – 1.57	0.11	0.96 – 1.56
Race/ Ethnicity†b	0.09	0.74 – 76.92	0.09	0.75 – 77.21	N/A	N/A	N/A	N/A
Other Degree†d	0.42	0.40 – 9.25	0.44	0.38 – 9.04	N/A	N/A	N/A	N/A
Specialty†e	0.16	0.05 – 1.65	0.17	0.05 – 1.67	N/A	N/A	N/A	N/A
HR Management ‡	0.25	0.88 -1.66	0.27	0.87 -1.65	N/A	N/A	N/A	N/A
Diagnostics‡	0.23	0.46 – 0.94	0.02	0.45 – 0.94	N/A	N/A	N/A	N/A
Internet Access‡	0.003	0.33 – 0.80	0.003	0.33 – 0.80	N/A	N/A	N/A	N/A
Antivirals/V accines‡	0.03	0.49 – 0.97	0.04	0.49 – 0.98	N/A	N/A	N/A	N/A
L/S/F Plans‡	0.03	0.35 – 0.94	0.04	0.35 – 0.97	N/A	N/A	N/A	N/A
Virus Pathology‡	0.02	1.12 – 2.80	0.02	1.10 – 2.79	N/A	N/A	N/A	N/A
L of P*	N/A	N/A	N/A	N/A	0.81	0.91 – 1.12	N/A	N/A
MD/DO + PM‡f	N/A	N/A	0.76	0.55 – 2.26	N/A	N/A	N/A	N/A

[a]referent group male, [b]referent group white, [c]referent group MD, [d]referent group yes, [e]referent group general practice, [f]effect measure modifier variable. *=continuous variable. †=dichotomous variable ‡=variable on Likert scale of 1 to 10. **First model with all predictors excluded if *p* value >.45, ***second model with all factors from previous model excluded if *p* value >.45, ****third model with all factors excluded if *p* value on univariate analyses >.25, *****final model excluding *p* values >.25 on univariate analyses and L of P predictor. 95% CI=95% confidence interval, L/S/F=local/state/federal, manip=manipulation, L of P=length of practice, MD=medical doctor, DO=doctor of osteopathy, PM=physical manipulation.

D. Full multivariable logistic regression model with effect measure modification.

Variable	Adjusted OR	95% CI	Adjusted OR	95% CI
Age*	1.22	0.987-1.518	N/A	N/A
Age†	N/A	N/A	2.96	0.236-36.999
Length of Practice*	0.99	0.855-1.148	1.07	0.938-1.228
Gender†[a]	35.66	1.244-1022.085	24.21	1.038-564.604
Race/Ethnicity†[b]	0.12	0.008-1.791	0.25	0.022-2.907
Degree†[c]	0.88	0.012-61.646	1.20	0.023-64.083
Other Degree†[d]	0.19	0.020-1.824	0.35	0.049-2.446
Specialty†[e]	13.63	0.677-274.406	9.73	0.646-146.438
Type of Institution†[f]	0.68	0.106-4.329	0.74	0.128-4.323
Population of Practice Served†[g]	0.04	0.001-1.314	0.09	0.005-1.705
HR Management‡	1.31	0.906-1.901	1.30	0.909-1.858
Diagnostics‡	0.53	0.319-0.867	0.55	0.342-0.872
Veterinarian Relationship‡	1.25	0.771-2.011	1.17	0.764-1.794
Patient Education‡	3.02	1.399-6.501	2.79	1.367-5.711
Rationing‡	1.03	0.673-1.562	1.07	0.722-1.581
Quarantine‡	0.89	0.516-1.531	0.89	0.534-1.464
Internet Access‡	0.41	0.219-0.762	0.48	0.292-0.796
Electronic Records‡	1.95	1.099-3.458	1.83	1.092-3.072
Pulmonologist‡	0.92	0.558-1.513	0.88	0.552-1.397
Antivirals/Vaccines‡	0.73	0.472-1.138	0.77	0.504-1.169
L/S/F Plans‡	0.52	0.262-1.021	0.58	0.319-1.053
Virus Knowledge‡	1.82	0.977-3.386	1.77	0.936-3.329
Personal Protection‡	1.17	0.484-2.831	1.30	0.527-3.204
Physical Manipulation‡	1.79	1.038-3.100	1.81	1.040-3.157
MD/DO * PM**	0.67	0.291-1.561	0.68	0.300-1.558

[A]referent group male, [b]referent group white, [c]referent group MD, [d]referent group yes, [e]referent group general practice, [f]referent group non-academic, [g]referent group non-metropolitan. *=continuous variable, **=effect measure modification variable, †=dichotomous variable, ‡=variable on Likert scale of 1 to 10. OR=odds ratio, 95% CI=95% confidence interval, L/S/F=local/state/federal, PM=physical manipulation, MD=medical doctor, DO=doctor of osteopathy.

E. Stratified multivariable logistic regression analyses

Variable	Adjusted OR**	95% CI	Adjusted OR ***	95% CI
Age*	0.27	0	38893.82	0
L of P*	5.58	0	0.001	0
Gender†[a]	8.34	0	1.10E+49	0
Race/Ethnicity†[b]	0.90	0	0	0
Other Degree†[d]	49.71	0	0	0
Specialty†[e]	1.00	0	4.00E+23	0
Type of Institution†[f]	1.00	0	4.08763.3	0
Population of Practice Served†[g]	1.00	0	0	0
HR Management‡	14.10	0	8.00E+07	0
Diagnostics‡	0.00	0	0	0
Veterinarian Relationship‡	0.20	0	2173071	0
Patient Education‡	549.08	0	6.00E+10	0
Rationing‡	0.00	0	0.292	0
Quarantine‡	3.61	0	0.045	0
Internet Access‡	0.00	0	0	0
Electronic Records‡	4590.71	0	3784478	0
Pulmonologist‡	1.59	0	0	0
Antivirals/Vaccines‡	16.71	0	0.003	0
L/S/F Plans‡	0.00	0	0	0
Virus Knowledge‡	190.75	0	3.00E+10	0
Personal Protection‡	0.08	0	177160.7	0
Physical Manipulation‡	0.66	0	6664.31	0

[a]referent group male, [b]referent group white, [c]referent group MD, [d]referent group yes, [e]referent group general practice, [f]referent group non-academic, [g]referent group non-metropolitan. *=continuous variable, †=dichotomous variable, ‡=variable on Likert scale of 1 to 10. ***n*=38 MD physicians, ***n*=48 DO physicians. OR=odds ratio, 95% CI=95% confidence interval, L of P=length of practice, L/S/F=local/state/federal, HR=human resources, PM=physical manipulation, MD=medical doctor, DO=doctor of osteopathy.

F. Avian Influenza Survey Tool

PREPAREDNESS RESPONSE QUESTIONS:

1. Have you established a plan to deal with the following human resource concerns in case of an influenza outbreak? Select all that apply.
    a. Absenteeism (1)
    b. Rotating Schedules (1)
    c. Sick Leave (1)
    d. None of these (0)
2. What diagnostic tests can you use to confirm a diagnosis of avian influenza infection? Select all that apply.
    a. RT-PCR (1)
    b. Immunofluorescent assay (1)
    c. None of these (0)
3. How capable are you of educating your patient population about the symptoms and sequelae of an influenza infection? Check the appropriate response below.
    a. Not capable (0)
    b. Capable (1)
4. How capable are you of educating local authorities about the symptoms and sequelae of an influenza infection? Check the appropriate response below.
    a. Not capable (0)
    b. Capable (1)
5. Do you provide your patients with information on how to prepare for a possible influenza virus outbreak?
    a. Yes (1)
    b. No (0)
6. True or False, the incubation period of the avian influenza virus is 1 to 4 days? Check the response below.
    a. True (1)
    b. False (0)
7. What is the most likely presentation of a patient with avian influenza infection? Check the response below.
    a. Temperature 100.4 degrees or higher, cough, and/or sore throat (1)*
    b. Respiratory arrest (0)
    c. Temperature 100.4 degrees or higher, Diarrhea, and/or vomitus (0)
    d. Asymptomatic (0)
8. What age group is at highest risk of death if infected with avian influenza? Check the response below.
    a. Newborns (0)
    b. Infants (0)
    c. Children (0)
    d. Adolescents/Young Adults* (1)
    e. Adults (0)
    f. Elderly (0)
9. Do you feel that physicians could be held liable if patients are quarantined and become infected?
    a. Yes (1)

b. No (0)

10. If you suspect a patient population is presenting with symptoms that are indicative of an avian influenza infection, whom would you contact first? Check the response below.
    a. City/County Health Department* (1)
    b. State Health Department (0)
    c. CDC (0)
    d. Local Hospital (0)
11. In an initial outbreak of avian influenza, which of the following is a proper measure to prevent the spread of avian influenza to others? Check the response below.
    a. Face masks/washing hands* (1)
    b. Avian influenza vaccine (0)
    c. Influenza vaccine yearly (0)
    d. Antiviral medication (0)
12. Do you have the capability of storing respiratory excretions for further research and analysis?
    a. Yes (1)
    b. No (0)
13. How capable do you feel of performing physical manipulation treatment with your patient population, such as chiropractic techniques or osteopathic manipulative treatment? Check the response below.
    a. Not capable (0)
    b. Capable (1)
14. How long after a pandemic do you expect the federal government to develop a vaccine for avian influenza?
    a. 1 week (0)
    b. 2 weeks (0)
    c. 1 month (0)
    d. 2 months (0)
    e. 6 months (1)*
    f. 1 year (0)
    g. >1 year (0)
15. A patient presents to your clinic with tachypnea, fever of 101^{0}F and an initial pulse oximeter reading of 98% oxygen saturation. After 30 minutes the patient has a respiratory rate of 12 bpm and is only able to speak with single words. The pulse oximeter is reading 92% oxygen saturation. What is the most appropriate step(s) in management for this patient? Check the response below.
    a. Begin oxygen application, arterial blood gas, chest X-ray (0)
    b. Begin oxygen application, arterial blood gas, urine output (0)
    c. Begin oxygen application, arterial blood gas, urine output, chest X-ray (0)
    d. Begin oxygen and admit to ICU (0)
    e. Begin oxygen application and transfer to ER* (1)
16. Do you have or do you plan to install electronic medical record capability within the next year?
    a. Yes (1)
    b. No (0)
17. Which of the following is an adverse event associated with oseltamivir (Tamiflu)? Check the response below.
    a. Seizures(0)

b. Delirium* (1)
c. Ototoxicity (0)
d. Cataracts (0)

18. How soon after development of symptoms should a patient be started on antiviral medications? Check the response below.
    a. ≤ 2 days* (1)
    b. 3 to 4 days (0)
    c. 5 to 6 days (0)
    d. ≥ 7 days (0)
19. Do you have the infrastructure to ensure referral of your patients to a pulmonologist if needed?
    a. Yes (1)
    b. No (0)

LIKERT SCALE QUESTIONS: Importance of Predictors for Preparedness

Please rank the following based on their importance, 1 (least important) to 10 (extremely important), in dealing with an avian influenza pandemic.

20. Human resource management during an influenza outbreak.
21. Diagnostic tests important in detecting influenza infections.
22. Having a relationship with a veterinarian to detect sick animals in the community.
23. Patient knowledge and education about the influenza virus and presenting symptoms.
24. Knowledge of the influenza virus and its natural course in successfully treating the disease.
25. Rationing of prescriptions and interventions in an eventual outbreak.
26. A physician's understanding of the local, state and federal pandemic influenza plans.
27. Personal protection among health care workers.
28. Physical manipulation treatments in treating the symptoms of the disease.
29. Quarantining infected individuals in limiting transmissibility.
30. Internet access and use to treat patients with influenza.
31. The role of electronic medical record systems in dealing with an influenza outbreak.
32. Having a working relationship with a pulmonary specialist during an influenza outbreak.
33. Anti-viral medications and vaccines in limiting the spread of avian flu.

DEMOGRAPHICS:

1. What is your age? (Type in your response in years)
2. What is your gender?
    a. Male (0)
    b. Female (1)
3. What is your race/ethnicity?
    a. White (0)
    b. Black/African American (1)
    c. Asian (2)
    d. Hispanic/Latino (3)
    e. Native Hawaiian or Other Pacific Islander (4)

f. American Indian or Alaska Native (5)

4. What is your medical degree?
   a. MD United States graduate (0)
   b. MD foreign graduate (1)
   c. DO (2)
5. What is your other degree?
   a. Master of Science (0)
   b. Master of Public Health (1)
   c. Master of Business Administration (2)
   d. Other Masters (3)
   e. Ph.D (4)
   f. Dr. Public Health (5)
   g. Other (6)
   h. None (7)
6. How long have you been a practicing physician since the end of your training? (Type in your response in years)
7. What is your primary specialty
   a. Family Medicine (0)
   b. Internal Medicine (1)
   c. Emergency Medicine (2)
   d. General Surgery (3)
   e. Pediatrics (4)
8. What is your subspecialty
   a. Pulmonology (0)
   b. Cardiology (1)
   c. Nephrology (2)
   d. Gastroenterology (3)
   e. Endocrinology (4)
   f. Infectious Disease (5)
   g. Dermatology (6)
   h. Gerontology (7)
   i. OB/gynecology (8)
   j. Ophthalmology (9)
   k. Neurology (10)
   l. None (11)
9. What best describes your practice?
   a. Rural Clinic (0)
   b. Urban Clinic (1)
   c. Suburban Clinic (2)
   d. Hospital/Inpatient care (3)
   e. Academic/Teaching Clinic (4)
10. What category below best describes the population of the community in which our primary practice is located?
    a. Less than 2,500 people (0)
    b. 2,500 to 19,999 people (1)
    c. 20,000 to 249,000 people (2)
    d. 250,000 to 999,999 people (3)
    e. Greater than or equal to 1,000,000 people (4)

REFERENCES

American College of, P., Barnitz, L., & Berkwits, M. (2006). The health care response to pandemic influenza. *Annals of Internal Medicine, 145*(2), 135-137.

American Public Health Association. (2008). Physicians slightly more confident in government's preparedness for avian flu; majority worried about human-to-human transmission. Retrieved 04/01, 2008, from http://www.apha.org/publications/tnh/archives/2006/11-06/WebExclusives/3012.htm.

Avian influenza: Flu virus research yields results but no magic bullet for pandemic. (2008). *Science, 319,* 1178.

Barclay, W. S., & Zambon, M. (2004). Pandemic risks from bird flu. *BMJ, 328*(7434), 238-239.

Bartlett, J. G. (2006). Planning for avian influenza. *Annals of Internal Medicine, 145*(2), 141-144. Basler, C. F. (2007). Influenza viruses: Basic biology and potential drug targets. *Infectious Disorders Drug Targets, 7*(4), 282-293.

Beaumont, M., Duggal, H. V., Mahmood, H., & Olowokure, B. (2007). A survey of the preparedness for an influenza pandemic of general practitioners in the west midlands, UK. *European Journal of Clinical Microbiology and Infectious Disease, 26*, 819-823. doi:10.1007/s10096-007-0377-2.

Beigel, J., & Bray, M. (2008). Current and future antiviral therapy of severe seasonal and avian influenza. *Antiviral Research, 78*(1), 91-102.

Beigel, J., & Bray, M. (2008). Current and future antiviral therapy of severe seasonal and avian influenza. *Antiviral Research, 78*(1), 91-102.

Beigel, J. H., Farrar, J., Han, A. M., Hayden, F. G., Hyer, R., de Jong, M. D., et al. (2005). Avian influenza A (H5N1) infection in humans. *The New England Journal of Medicine, 353*(13), 1374-1385.

Belshe, R. B. (2005). The origins of pandemic influenza--lessons from the 1918 virus. *New England Journal of Medicine, 353*(21), 2209-2211.

Boehm, K. M., Lawner, B. J., & McFee, R. B. (2003). Study raises important issues about the potential benefit of osteopathy in the cranial field to patients with parkinson's disease. *The Journal of the American Osteopathic Association, 103*(8), 354-5; author reply 355-6.

Boon, A. C., Sandbulte, M. R., Seiler, P., Webby, R. J., Songserm, T., Guan, Y., et al. (2007). Role of terrestrial wild birds in ecology of influenza A virus (H5N1). *Emerging Infectious Diseases, 13*(11), 1720-1724.

Business Wire. (2005). *Physicians question government preparedness for avian bird flu; majority believe government, medical community ill-prepared.* Retrieved 04/01, 2008, from http://findarticles.com/p/articles/mi_m0EIN/is_2005_Oct_24/ai_n15730932

CDC. *Information about influenza pandemics.*, 2008, from http://www.cdc.gov/flu/avian/gen-info/pandemics.htm.

CDC. (2005). *Public health guidance for community-level preparedness and response to severe acute respiratory syndrome (SARS) version 2.* Retrieved 04/12, 2008, from http://www.cdc.gov/ncidod/sars/guidance/C/index.htm.

CDC. (2008). *Strategic national stockpile.* Retrieved 04/12, 2008, from http://www.bt.cdc.gov/stockpile/index.asp.

Chandrasekaran, A., Srinivasan, A., Raman, R., Viswanathan, K., Raguram, S., Tumpey, T. M., et al. (2008). Glycan topology determines human adaptation of avian H5N1 virus hemagglutinin. *Nature Biotechnology, 26*(1), 107-113.

Choi, J. G., Lee, Y. J., Kim, Y. J., Lee, E. K., Jeong, O. M., Sung, H. W., et al. (2008). An inactivated vaccine to control the current H9N2 low pathogenic avian influenza in korea. *Journal of Veterinary Science (Suwon-Si, Korea), 9*(1), 67-74.

Cole, A. (2006). Two thirds of doctors in UK say the NHS could not cope with bird flu epidemic. *British Medical Journal, 333*(7570), 674. doi:10.1136/bmj.333.7570.674-a.

Comments from the center for biosecurity of UPMC on the national strategy for pandemic influenza: Implementation plan.(2006). *Biosecurity & Bioterrorism, 4*(3), 320-324.

Conly, J. M., & Johnston, B. L. (2004). Avian influenza - the next pandemic? The Canadian Journal of Infectious Diseases & Medical Microbiology = Journal Canadien Des Maladies Infectieuses Et De La Microbiologie Medicale / AMMI Canada, 15(5), 252-254.

Dudley, G., & McFee, R. B. (2005). Preparedness for biological terrorism in the united states: Project BioShield and beyond. *The Journal of the American Osteopathic Association, 105*(9), 417-424.

Enserink, M., & Normile, D. (2007). Avian influenza. more bumps on the road to global sharing of H5N1 samples. *Science (New York, N.Y.), 318*(5854), 1229.

Escorcia, M., Vazquez, L., Mendez, S. T., Rodriguez-Ropon, A., Lucio, E., & Nava, G. M. (2008). Avian influenza: Genetic evolution under vaccination pressure. *Virology Journal, 5*, 15.

Gaglia Jr., M. A., Cook, R. L., Kraemer, K. L., & Rothberg, M. B. Patient knowledge and attitudes about avian influenza in an internal medicine clinic. *Public Health, In Press, Corrected Proof.*

Gammie, A. J. (2008). For the proposition: For the diagnosis of viral infections, commercial assays provide more reliable results than do in-house assays. *Reviews in Medical Virology, 18*(2), 73-76.

Garrett, L., & Fidler, D. P. (2007). Sharing H5N1 viruses to stop a global influenza pandemic. *PLoS Medicine, 4*(11), e330.

Gilbert, M., Xiao, X., Pfeiffer, D. U., Epprecht, M., Boles, S., Czarnecki, C., et al. (2008). Mapping H5N1 highly pathogenic avian influenza risk in southeast asia. *Proceedings of the National Academy of Sciences of the United States of America.*

Hayden, F. G. (2006). Antiviral resistance in influenza viruses--implications for management and pandemic response. *New England Journal of Medicine, 354*(8), 785-788.

He, J. F., Lv, X., Cheng, X. W., Wu, C. L., Zhang, S. X., Shu, Y., et al. (2008). Laboratory diagnosis and molecular characterization analysis of the H5N1 influenza virus isolated from the first human case in shenzhen, china. *Bing Du Xue Bao = Chinese Journal of Virology / [Bian Ji, Bing Du Xue Bao Bian Ji Wei Yuan Hui], 24*(1), 28-33.

Hruby, R. J., & Hoffman, K. N. (2007).
Avian influenza: An osteopathic component to treatment. *Osteopathic Medicine and Primary Care,* doi:10.1186/1750-4732-1-10.

Hsieh, Y. C., Wu, T. Z., Liu, D. P., Shao, P. L., Chang, L. Y., Lu, C. Y., et al. (2006). Influenza pandemics: Past, present and future. *Journal of the Formosan Medical Association, 105*(1), 1-6.

Jeffery K. Taubenberger, Ann H. Reid, Raina M. Lourens, Ruixue Wang, Guozhong Jin, & Thomas G. Fanning. (2005). Characterization of the 1918 influenza virus polymerase genes. *Nature, 437,* 889.

Knott, E. M., Tune, J. D., Stoll, S. T., & Downey, H. F. (2005). Increased lymphatic flow in the thoracic duct during manipulative intervention. *Journal of the American Osteopathic Association, 105*(10), 447-456.

Landon, M. R., Amaro, R. E., Baron, R., Ngan, C. H., Ozonoff, D., McCammon, J. A., et al. (2008). Novel druggable hot spots in avian influenza neuraminidase H5N1 revealed by computational solvent mapping of a reduced and representative receptor ensemble. *Chemical Biology & Drug Design, 71*(2), 106-116.

Liem, N. T., Nakajima, N., Phat, L. P., Sato, Y., Thach, H. N., Hung, P. V., et al. (2008). H5N1-infected cells in lung with diffuse alveolar damage in exudative phase from a fatal case in vietnam. *Japanese Journal of Infectious Diseases, 61*(2), 157-160.

Long, J. X., Peng, D. X., Liu, Y. L., Wu, Y. T., & Liu, X. F. (2008). Virulence of H5N1 avian influenza virus enhanced by a 15-nucleotide deletion in the viral nonstructural gene. *Virus Genes.*

Louie, C. (2005). Avian influenza: Myth or mass murder? The Canadian Journal of Infectious Diseases & Medical Microbiology = Journal Canadien Des Maladies Infectieuses Et De La Microbiologie Medicale / AMMI Canada, 16(3), 197-201.

Mackay, W. G., van Loon, A. M., Niedrig, M., Meijer, A., Lina, B., & Niesters, H. G. (2008). Molecular detection and typing of influenza viruses: Are we ready for an influenza pandemic? *Journal of Clinical Virology : The Official Publication of the Pan American Society for Clinical Virology,*

Mair, M. (2006). National strategy for pandemic influenza released; $3.8 billion appropriated for pandemic preparedness. *Biosecurity & Bioterrorism, 4*(1), 2-5.

McConnell, C. P. (2000). The treatment of influenza. 1918. *Journal of the American Osteopathic Association, 100*(5), 311-313.

McFee, R. B. (2007). Avian influenza: The next pandemic? *Disease-a-Month : DM, 53*(7), 348-387.

McFee, R. B. (2007). Global infections--avian influenza and other significant emerging pathogens: An overview. *Disease-a-Month : DM, 53*(7), 343-347.

Mesina, J., Hampton, D., Evans, R., Ziegler, T., Mikeska, C., Thomas, K., et al. (1998). Transient basophilia following the application of lymphatic pump techniques: A pilot study. *Journal of the American Osteopathic Association, 98*(2), 91.

Morens, D. M., & Fauci, A. S. (2007). The 1918 influenza pandemic: Insights for the 21st century. *Journal of Infectious Diseases, 195*(7), 1018-1028.

Mossad, S. B. (2007). Influenza update 2007-2008: Vaccine advances, pandemic preparation. *Cleveland Clinic Journal of Medicine, 74*(12), 889-894.

Nandi, T. (2008). Proposed lead molecules against hemagglutinin of avian influenza virus (H5N1). *Bioinformation, 2*(6), 240-244.

Nap, R. E., Andriessen, M. P., Meessen, N. E., & van der Werf, T. S. (2007). Pandemic influenza and hospital resources. *Emerging Infectious Diseases, 13*(11), 1714-1719.

Nettleton, J. A., & Self, G. (2007). Recovering from a flu pandemic. for hospitals, recovery can be as demanding as the event itself. *Health Progress (Saint Louis, Mo.), 88*(6), 32-37.

Nicoll, A. (2008). Children; avian influenza H5N1 and pandemics. *Archives of Disease in Childhood,*

Normile, D. (2008). AVIAN INFLUENZA: Flu virus research yields results but no magic bullet for pandemic. *Science, 319*(5867), 1178-1179.

Optimization of the gene composition of influenza H5 virus hemagglutinin-containing reassortants and their efficacy in immune cross-protection experiments.(2008). *Voprosy Virusologii, 53*(1), 24-27.

Ortiz, E. J., Kochel, T. J., Capuano, A. W., Setterquist, S. F., & Gray, G. C. (2007). Avian influenza and poultry workers, peru, 2006. *Influenza Other Respir.Viruses, 1*(2), 65-69.

PC Gruber, Gomersall CD, & Joynt GM. (2006). Avian influenza (H5N1): Implications for intensive care. *Intensive Care Medicine,* 823.

Ray, K., Potdar, V. A., Cherian, S. S., Pawar, S. D., Jadhav, S. M., Waregaonkar, S. R., et al. (2008). Characterization of the complete genome of influenza A (H5N1) virus isolated during the 2006 outbreak in poultry in india. *Virus Genes, 36*(2), 345-353.

Sakabe, S., Sakoda, Y., Haraguchi, Y., Isoda, N., Soda, K., Takakuwa, H., et al. (2008). A vaccine prepared from a non-pathogenic H7N7 virus isolated from natural reservoir conferred protective immunity against the challenge with lethal dose of highly pathogenic avian influenza virus in chickens. *Vaccine,* Santibanez, S. (2007). Faith-based organizations and pandemic preparedness. church-related groups will be vital partners in getting ready for an influenza pandemic. *Health Progress (Saint Louis, Mo.), 88*(6), 26-31.

Schunemann, H. J., Hill, S. R., Kakad, M., Bellamy, R., Uyeki, T. M., Hayden, F. G., et al. (2007). WHO rapid advice guidelines for pharmacological management of sporadic human infection with avian influenza A (H5N1) virus. *The Lancet Infectious Diseases, 7*(1), 21-31.

Silvagni, A. J., Levy, L. A., McFee, R. B., & NOVA Southeastern University-College of Osteopathic Medicine Task Force on Bioterrorism and Weapons of Mass Destruction. (2002). Educating health professionals, first responders, and the community about bioterrorism and weapons of mass destruction. *The Journal of the American Osteopathic Association, 102*(9), 491-499.

Silvagni, A. J., Levy, L. A., McFee, R. B., & NOVA Southeastern University-College of Osteopathic Medicine Task Force on Bioterrorism and Weapons of Mass Destruction. (2002). Educating health professionals, first responders, and the community about bioterrorism and weapons of mass destruction. *The Journal of the American Osteopathic Association, 102*(9), 491-499.

Sleszynski, S., & Kelso, A. (1993). Comparison of thoracic manipulation with incentive spirometry in preventing postoperative atelectasis. *Journal of the American Osteopathic Association, 93*(8), 834.

Soda, K., Sakoda, Y., Isoda, N., Kajihara, M., Haraguchi, Y., Shibuya, H., et al. (2008). Development of vaccine strains of H5 and H7 influenza viruses. *The Japanese Journal of Veterinary Research, 55*(2-3), 93-98.

Suptawiwat, O., Kongchanagul, A., Chan-It, W., Thitithanyanont, A., Wiriyarat, W., Chaichuen, K., et al. (2008). A simple screening assay for receptor switching of avian influenza viruses. *Journal of Clinical Virology : The Official Publication of the Pan American Society for Clinical Virology,*

Taubenberger, J. K., & Morens, D. M. (2008). The pathology of influenza virus infections. *Annual Review of Pathology, 3*, 499-522.

Tosh, P. K., & Poland, G. A. (2008). Emerging vaccines for influenza. *Expert Opinion on Emerging Drugs, 13*(1), 21-40.

United States Department of Health & Human Services. (2007). *HHS pandemic influenza plan.* Retrieved 03/31, 2008, from http://www.hhs.gov/pandemicflu/plan/

Veits, J., Romer-Oberdorfer, A., Helferich, D., Durban, M., Suezer, Y., Sutter, G., et al. (2008). Protective efficacy of several vaccines against highly pathogenic H5N1 avian influenza virus under experimental conditions. *Vaccine, 26*(13), 1688-1696.

von Itzstein, M. (2008). Avian influenza virus, a very sticky situation. *Current Opinion in Chemical Biology,*

Washington, K., Mosiello, R., Venditto, M., Simelaro, J., Coughlin, P., Crow, W., et al. (2003). Presence of chapman reflex points in hospitalized patients with pneumonia. *Journal of the American Osteopathic Association, 103*(10), 479-483.

WHO.

Avian influenza ("Bird flu") and the significance of transmission to humans., 2007, from http://www.who.int/mediacentre/factsheets/avian_influenza/en.

WHO. *Avian influenza: Assessing the pandemic threat.*, 2007, from http://www.who/cds/2005.29

WHO. *Estimating the impact of the next influenza pandemic: Enhancing preparedness.*, 2007, from

http://www.who.int/csr/disease/influenza/preparedness2004_12_08/en/index.htm
l

WHO. *Ten things you need to know about pandemic influenza.*, 2008, from http://www.who.int/csr/disease/influenza/pandemic10things/en/index.html.

WHO. (2005). *WHO checklist for influenza pandemic preparedness planning.* Retrieved 04/10, 2008, from http://www.who.int/csr/resources/publications/influenza/WHO_CDS_CSR_GIP_2005_4/en/

Wilgis, J. (2008). Strategies for providing mechanical ventilation in a mass casualty incident: Distribution versus stockpiling. *Respiratory Care, 53*(1), 96-100.

Williams, R. A., Fasina, F. O., & Peterson, A. T. (2008). Predictable ecology and geography of avian influenza (H5N1) transmission in nigeria and west africa. *Transactions of the Royal Society of Tropical Medicine and Hygiene,*

Wong, T. Y., Koh, G. C., Cheong, S. K., Lee, H. Y., Fong, Y. T., Sundram, M., et al. (2008). Concerns, perceived impact and preparedness in an avian influenza pandemic - a comparative study between healthcare workers in primary and tertiary care. *Annals of the Academy of Medicine, Singapore, 37*(2), 96-97.

Writing Committee of the Second World Health Organization Consultation on Clinical Aspects of Human Infection with Avian Influenza A (H5N1) Virus, Abdel-Ghafar, A. N., Chotpitayasunondh, T., Gao, Z., Hayden, F. G., Nguyen, D. H., et al. (2008). Update on avian influenza A (H5N1) virus infection in humans. *The New England Journal of Medicine, 358*(3), 261-273.

Wu, W. L., Chen, Y., Wang, P., Song, W., Lau, S. Y., Rayner, J. M., et al. (2008). Antigenic profile of avian H5N1 viruses in asia from 2002 to 2007. *Journal of Virology, 82*(4), 1798-1807.

Xing, Z., Cardona, C., Dao, P., Crossley, B., Hietala, S., & Boyce, W. (2008). Realtime RT-PCR assay unable to detect H7 subtype avian influenza viruses isolated from wild birds. *Journal of Clinical Microbiology,*

Yang, Y., Halloran, M. E., Sugimoto, J. D., & Longini, I. M.,Jr. (2007). Detecting human-to-human transmission of avian influenza A (H5N1). *Emerging Infectious Diseases, 13*(9), 1348-1353.

Yu, H., Feng, Z., Zhang, X., Xiang, N., Huai, Y., Zhou, L., et al. (2007). Human influenza A (H5N1) cases, urban areas of people's republic of china, 2005-2006. *Emerging Infectious Diseases, 13*(7), 1061-1064.