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The H5N1 Avian Influenza Virus: Globalization, Climate Change, and Other Anthropogenic Factors in New Emergent Diseases

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Introduction:

The avian flu is a current and significant issue involving the global environment as well as the health of millions of people around the world. In the past few months, the imminent threat of an avian flu pandemic had drawn increasing public attention. This is due to the rapid spread of the virus among birds and to humans as well. In order to better battle the virus, we must develop a deeper understanding of how the avian flu works, where is comes from and how it affects the global environment as well the health of animals and humans.

The threat of the H5N1 avian influenza virus has been speculated to begin within the Guangdong Province deep within China; it has been known to be the "birthplace of the flu." This is because it is an area where animals and humans live in close proximity to each other for thousands of years, thus providing more opportunities for a virus to jump from animals to humans. This environmental factor becomes a dangerous living arrangement when it comes to the issue of the spread of diseases, such as the H5N1 influenza. Sadly, the story of the H5N1 avian influenza only begins there; it has spread to multiple continents and may be on the verge of becoming a global epidemic. So far, the hardest hit country is Vietnam. With multiple environmental, social, and ecological factors that promote the propagation of the virus, the country itself has become a microcosm of the impending pandemic of this new type of influenza among humans.

With a focus on the multiple factors that aid in the spread of the avian influenza in Vietnam, as well as other global environmental factors, we can strengthen our comprehension of the patterns of distribution of the virus as well as the environmental and physicochemical components that help promote and propagate it. By furthering the knowledge of these factors, we can better determine how to implement systems in which to contain the virus and treat the victims of the influenza.

Therefore, this paper will address the different environmental, ecological, and social factors within Vietnam as well as globally that has made it a prime breeding ground for the H5N1 virus and its advancement. Others topics to be discussed will include: a study of another emerging virus that may prove to be a model for the H5N1 virus, an overview of the H5N1 avian influenza virus, the environmental circumstances that lead to the emergence and acceleration of the disease, the human transmission of the H5N1 avian influenza virus, environmental factors that lead to the spread of the virus within Vietnam and globally, and possible prevention policies.

Model for the H5N1 Avian Influenza Virus, West Nile:

The spread and transmission of the West Nile virus can be used as prime example of how the environment plays a major part in the acceleration and progression of a virus both locally and globally. It is a virus that has many similarities in relation to the H5N1 virus. One similarity is that it is a virus that spreads through the use of a vector, in the case of the West Nile virus, it is mosquitoes, in the case of the H5N1 virus, it is birds. Another similarity in between these viruses is the condition that both viruses cannot be spread by human to human transmission. Through these factors, both environmental and

man-made, the West Nile virus has made its way from the far regions of its origins into urban areas all over the world.

The West Nile virus was first reported in Uganda in 1937, even in today's world it is still most commonly found in Africa, West Asia, Europe, and the Middle East. In the summer of 1999, the West Nile virus surprised scientists and was found North America, more specifically in New York City. Since its first appearance in New York City, it has been seen in birds and mosquitoes in every state in the United States except Alaska and Hawaii. West Nile virus has now been named a seasonal endemic within the United States.

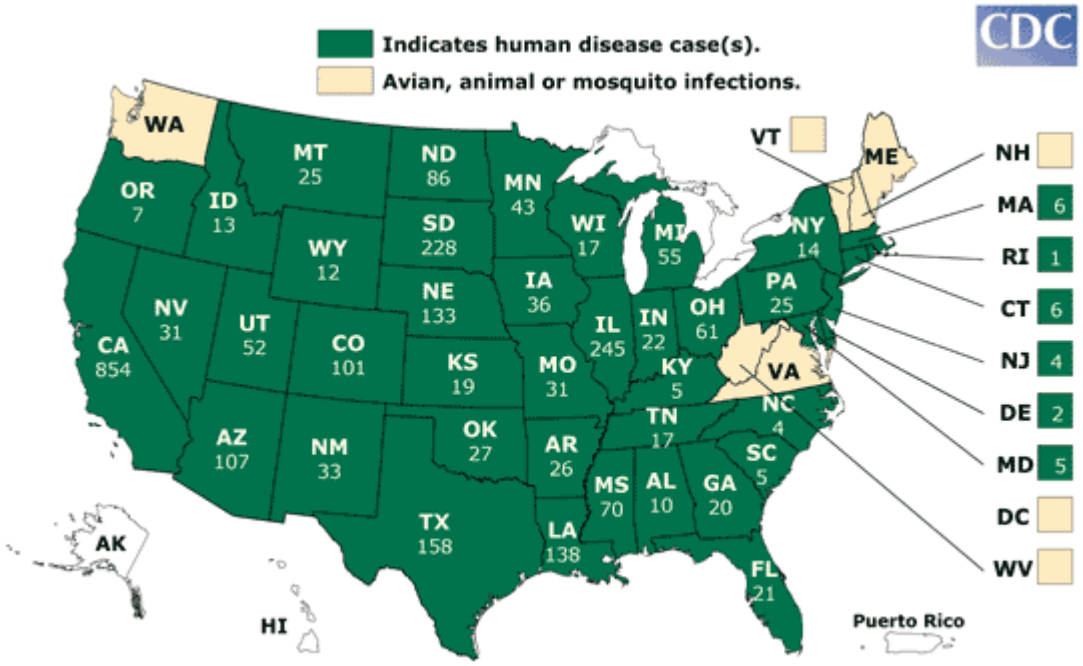

Figure 1: West Nile virus activity within the United States. Data reported to the Center for Disease Control on December 6, 2005.

The West Nile virus is a mosquito-borne virus that can cause a wide range of symptoms with varying severity in humans. The most fatal consequence of contracting the West Nile virus is encephalitis, the inflammation of the brain, the membranes

surrounding the brain and the spinal cord. Other serious symptoms of the virus include fever, stupor, neck stiffness, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness, and paralysis. Some of these symptoms are temporary; however the neurological symptoms may become permanent. Individuals of all ages are susceptible to this virus through mosquitoes; however the West Nile virus proves to be more of a danger to the elderly and young children in terms of the severity of the symptoms and the permanent damage that it may cause.

Natural environmental conditions and factors that led to the spread of the West Nile virus all the way to North America include local conditions such as the multiple sites and locations which prove to be advantageous to the proliferation of the vector of the virus, the mosquitoes. Another environmental factor that led to the spread of the West Nile virus to North America is global warming. In combination with other man-made environmental factors, the spread of the West Nile virus in North America was made possible by these local as well as global natural environmental factors.

Local natural environmental factors within New York City made the location advantageous for the West Nile virus to become endemic to the city during the summers. In a concentrated urban location such as the city, there are various places in which stagnant water will collect throughout the area after a rainfall. These accumulations of stagnant water make them a choice location for the breeding of mosquitoes, which may carry the West Nile virus.

Global warming is also an enormous contributor the expansion of the West Nile virus to North America. It is global warming that has provided North America with unusually high temperatures during the summer months which allow for the vectors of

West Nile virus to thrive in an area that they would not normally live for long. The warmer temperatures in New York City due to global warming permitted mosquitoes to breed and infect the local bird population as well as humans.

In addition to the natural environmental factors that provided optimal conditions for the West Nile virus to expand, there are also local and global man-made environmental factors that allow for the continuing advancement of the West Nile virus. One of the local man-made environmental factors is the dense population over a small location, which is characteristic of most cities, especially New York City. A global environmental factor that affects the travel of this virus is the transport of animals that may carry the West Nile virus. Both man-made environmental factors have made a tremendous impact on the speed and range of distribution of the propagation of the virus.

Local man-made environmental factors such as the concentrated amount of people over a small space provide the opportunity of mosquitoes that carry the West Nile virus to infect more people over its short life span. Another man-made environmental factor that contributes to the rise in population of mosquitoes is the multiple products that can collect rainwater and become a makeshift habitat for the breeding of mosquitoes. Some of these products include, bird baths, junk yards, and many others that can collect rainfall.

Global travel of animals can lead to the inadvertent movement of viruses. There are multiple animals which can be infected with the West Nile virus, some of which include birds, pigs, dogs, cats, and sometimes horses. These animals may be transported to other locations and a non-infected mosquito may bite infected animals and then transfer the virus to other animals in an area that had no previous occurrence of the virus. Therefore, transported animals can perpetuate a cycle in which the virus is transferred

from mosquito to animals and to possibly humans. With the propagation of the virus in other animals, the virus can move quickly to other areas in this way.

By observing the many factors that contribute to the spread of the West Nile virus, it can also allow for further insights into how the H5N1 avian influenza virus may possibly spread and travel across the world as well. The West Nile virus supplies a model in which, according to the similarities between the West Nile virus and the H5N1 avian influenza virus may show scientists how to better estimate the pathways of distribution of the virus. The H5N1 avian influenza virus is an absolutely separate entity from any other known virus; however by studying the patterns of similar viruses, it can provide scientists insight into the possible scenarios that may occur.

The H5N1 Avian Influenza Virus, An Overview:

Influenza A (H5N1) virus, also called H5N1 virus, is an influenza A virus subtype that occurs mainly in birds, is highly contagious among birds, and can be deadly to them. The avian influenza is an infection caused by viruses that naturally occurs among birds. The virus is contagious among multiple types of birds and can make some domesticated birds; including chickens, ducks, and turkeys, very sick and can potentially kill them. Vulnerable birds become infected when they come in contact with contaminated secretions or with surfaces that are contaminated with secretions from infected birds. The infection of avian influenza viruses in domestic poultry causes two main forms of the disease that are distinguished by low and high extremes of virulence. The highly pathogenic form spreads more rapidly through flocks of poultry. This form may cause diseases that affects multiple internal organs and has a mortality rate that can reach 90 to a 100 percent often within 48 hours.

Outbreaks of avian influenza H5N1 occurred among poultry in eight countries in Asia during late 2003 and early 2004. These countries are Cambodia, China, Indonesia, Japan, Laos, South Korea, Thailand, and Vietnam. At that time, more than 100 million birds in the affected countries either died from the disease or were killed in order to try to control the outbreaks. By March 2004, the outbreaks were reported to be under control due to the large groups of domesticated poultry as well as wild birds being destroyed. Since late June 2004, however, new outbreaks of influenza H5N1 among poultry were reported by several countries in Asia and Europe. These countries are Cambodia, China, Indonesia, Kazakhstan, Malaysia, Mongolia, Russia, Thailand, and Vietnam. The H5N1 avian influenza virus infection also has been reported among poultry in Turkey and Romania and among wild migratory birds in Croatia. Human cases of H5N1 avian influenza virus infection have been reported in Cambodia, China, Indonesia, Thailand, and Vietnam. The country of Vietnam is being hit the most heavily with human and animal deaths due to natural and man-made ecological and environmental factors that help the virus proliferate within their communities.

Human Transmission:

The avian influenza is very species-specific, but in rare cases has been known to cross the species barrier and affect humans. During an outbreak of avian influenza among poultry, there is a possible risk to people who have contact with infected birds or surfaces that have been contaminated with secretions from infected birds. Symptoms of avian influenza in humans have ranged from typical human influenza-like symptoms and other severe and life-threatening complications. There are only three known subtypes of influenza A viruses, which are the H1N1, H1N2, and H3N2 viruses currently circulating

among humans. It is likely that some genetic parts of current human influenza A viruses came from birds originally. Influenza A viruses are constantly changing, and they might adapt over time to infect and spread among humans.

One of the first instances of the H5N1 influenza outbreak among humans was in Hong Kong in 1997; Dr. Margaret Chan was the city's director of health at the time. At the confirmation that it was the H5N1 virus, she ordered the eradication of the disease's presumable host, 1.4 million ducks and chickens within the city, thus causing the temporary withdrawal of the disease. The disease killed six people of eighteen individuals with documented clinical cases of the virus.

The risk from avian influenza is generally low to most people because the viruses occur mainly among birds and do not usually infect humans. However, more than 100 human cases of avian influenza infection have been reported since 1997. Most cases of avian influenza infection in humans have resulted from contact with infected poultry or surfaces contaminated with secretions from infected birds. The spread of avian influenza viruses from one ill person to another has been reported very rarely, and transmission has not been observed to continue beyond one person.

Of the few avian influenza viruses that have crossed the species barrier to infect humans, H5N1 has caused the largest number of detected cases of severe disease and death in humans. In the current outbreaks in Asia and Europe, more than half of those infected with the virus have died. Most cases have occurred in previously healthy children and young adults. However, it is possible that the only cases currently being reported are those in the most severely ill people, and that the full range of illnesses caused by the H5N1 virus has not yet been defined.

So far, the spread of H5N1 virus from person to person has been rare and has not continued beyond one person. Nonetheless, because all influenza viruses have the ability to mutate, scientists are concerned that the H5N1 virus could be able to infect humans and spread easily from one person to another. Because these viruses do not commonly infect humans, there is little or no immune protection against them in the human population. If the H5N1 virus were to gain the capacity to spread easily from person to person, an influenza pandemic otherwise known as a worldwide outbreak of disease could begin. No one can predict when a pandemic might occur. However, experts from around the world are watching the H5N1 avian influenza virus situation in Asia and Europe very closely and are preparing for the possibility that the virus may begin to spread more easily and widely from person to person.

H5N1 Avian Influenza, The Physicochemical Components of the Virus:

The H5N1 avian influenza virus is barely one-thousandth of a millimeter; it has to be magnified 200,000 times in order to be seen on an electron microscope. This incredibly small life-form can potentially be the cause of a pandemic that in theory; could be the greatest killer in human history. This virus could conceivably take the lives of millions, even hundreds of millions of people all around the world. The increased understanding of how physicochemical factors affect the propagation of this virus might provide insight which can be useful in determining a policy in order to prevent or at the very least stall the pandemic.

In order for a virus to become a full blown pandemic, it has to fulfill three conditions outlined by the World Health Organization. The first prerequisite being that it has to be an entirely new strain of virus that is unknown to humans for more than a

century. The next qualification is that the virus has been proven to jump species. And finally the last stipulation that constitutes the definition of a pandemic is known instances of the virus being transmitted easily and freely from human to human. So far, the H5N1 avian influenza virus has completed two of the three provisions.

In dealing with the first provision, the H5N1 virus is an absolutely new strain of virus that is not known to humans. This virus, until the past decade has been known to affect birds only and at different intensities. The fact that it is unknown to humans for more than a century means that no human is immune to the virus. Without prior knowledge of the virus, the human body is not equipped to attack the virus and prevent it from ravaging the body and its systems.

Since it is an entirely unknown virus to the human body, the H5N1 avian influenza virus is a dangerous virus that can cause many potentially fatal secondary symptoms within the body. The virus works by entering the body and invading an individual cell. Within the cell, the virus will essentially seize the cell's life materials and replicates itself at a rapid rate. When the virus and its multiple copies break out of the now dead cell, it will continue to invade various cells of the body, thus killing the cells. By doing so, the virus will cause fluid to flood the lungs. The affected individual will either die by basically drowning in their own fluids or of many other secondary problems, which range from fever, cough, sore throat, and muscle aches to eye infections, pneumonia, severe respiratory diseases, the least of which include acute respiratory distress. In reported cases of individuals affected with the H5N1 virus, it can be clearly seen that the virus has successfully accomplished the first condition necessary to become a pandemic.

The second condition that must be fulfilled by the H5N1 virus is the ability to jump from species to species. There have been various instances of the avian virus found in multiple species of animals. There have been cases where the avian influenza virus was present in dogs, cats, and pigs. The most notable case however was in 2004; when the avian influenza virus killed 147 Bengal tigers in a Thailand zoo. Scientists are still determining if theses cases of avian influenza in other animals can also cause spread to humans, but as so far, the only method in which to contract the avian influenza virus is still through direct contact with infected poultry or contact with secretions of infected poultry. The instance of the presence of the H5N1 influenza virus among different species demonstrates the accelerated evolution of the virus itself.

The H5N1 avian influenza virus has been described by many scientists as a sloppy, capricious and promiscuous virus. The H5N1 virus, once it has entered a living cell can produce 100,000 copies of itself within an hour, with each succeeding copy making another 100,000 copies. At such a breakneck speed of breeding, the virus will most certainly make mistakes in its copying and end up with various mutations. It then becomes possible that one of these mutations will have the right combination which allows it to travel easily from human to human. The H5N1 virus, with its quick advancement in terms of evolution, has allowed it to satisfy the second prerequisite for a potential pandemic.

The final and third qualification for defining a pandemic has not yet been fulfilled by the H5N1 virus. Despite its quick evolutionary rate, the avian influenza virus has yet been able to be easily transmitted from person to person. There have been cases in which humans have passed the virus to one another, but not yet easily and regularly. Once this

final condition has been met the H5N1 virus, it will become a full blown pandemic that the world is not prepared for.

There are two ways in which scientists speculate that the H5N1 virus will be able to make the jump into the third condition. One possibility is that since the evolutionary rate of the virus is so accelerated and careless, the virus will on its own, stumble across a mutation that will have the correct combination that will allow it to be transmitted from human to human. The other possibility, the more likely one according to world scientists, is that the H5N1 virus will infect an individual who already has the human influenza virus. By doing so, the H5N1 virus could exchange genes with the human virus and therefore become easy to pass on. Whichever way the H5N1 virus chooses to cross the threshold into becoming a pandemic, it has become only a matter of time.

The Environmental Factors Within Vietnam:

Within the microcosm of the country of Vietnam, the people have been hit with the virus most heavily, so much so that the World Health Organization has called it an endemic within the nation. It can be seen that numerous environmental factors play an imperative role in the promotion of the H5N1 avian influenza virus among humans. By examining how such environmental factors in Vietnam are aiding in the spread of the disease among animals and humans, the world can be able to battle the virus more competently.

One of the major environmental factors that has become a main issue is that of the living arrangements between animals and humans. In the Southeast Asia, more specifically the country of Vietnam, the majority of people reside in rural areas and make their livelihood by sustenance farming or live in crowded city areas. It is in situations like

those in which the greater number of Vietnamese citizens live that provide a choice environment for the H5N1 virus to thrive.

In both the big cities and the small rural villages alike, animals such as poultry are in close quarters with their owners. For the citizens of Vietnam, the raising of animals such as poultry is a large part of their family income, which makes it an important part of their daily lives. In some cases, the animals share sleeping quarters with their owners. These types of living situations bring about optimal transmission of the H5N1 avian influenza virus from animals to humans. In other cases, seen throughout the country, mostly in the urban areas, there is just simply not enough living space to keep animals and people separate. By combining the living areas of both animals and the general population, infections of the virus become more likely to spread to humans.

The Main Global Environmental Factors:

There are different environmental factors that affect the H5N1 avian influenza virus in various parts of the globe. However, there are two major environmental and ecological factors that span the entire world and are becoming large players in relation to the spread of the H5N1 virus among birds internationally and soon; when the virus fulfills the third condition of a pandemic, a major health issue for humans as well. For the time being, the H5N1 avian influenza virus remains easily transmitted among birds only.

The seasonal migration of birds can allow for the spread of the disease from continent to continent. An instance in which migration of birds has caused the spread of the disease is in the case in which 5,000 birds, primarily bar-headed geese died of an H5N1 influenza infection in western China in the vicinity of the two-mile high Qinghai Lake in August of 2005. More than 100,000 rare birds and 189 types of avian species

including the bar-headed geese migrate to and from Qinghai Lake each year. These birds migrate in a crisscross pattern that will lead as far as Europe, Australia and America.

The migratory patterns of different birds are interconnected and will at some point in time cross each other, which will permit the virus to be transferred to another group of birds heading to another part of the world, thus spreading the H5N1 avian influenza virus to all the corners of the world. In some cases, the migratory birds are silent carriers of the virus, exhibiting none of the symptoms characteristic of the H5N1 avian influenza virus. In this way, the birds are carrying this potentially deadly disease from one point to another and spreading it to other birds along the way.

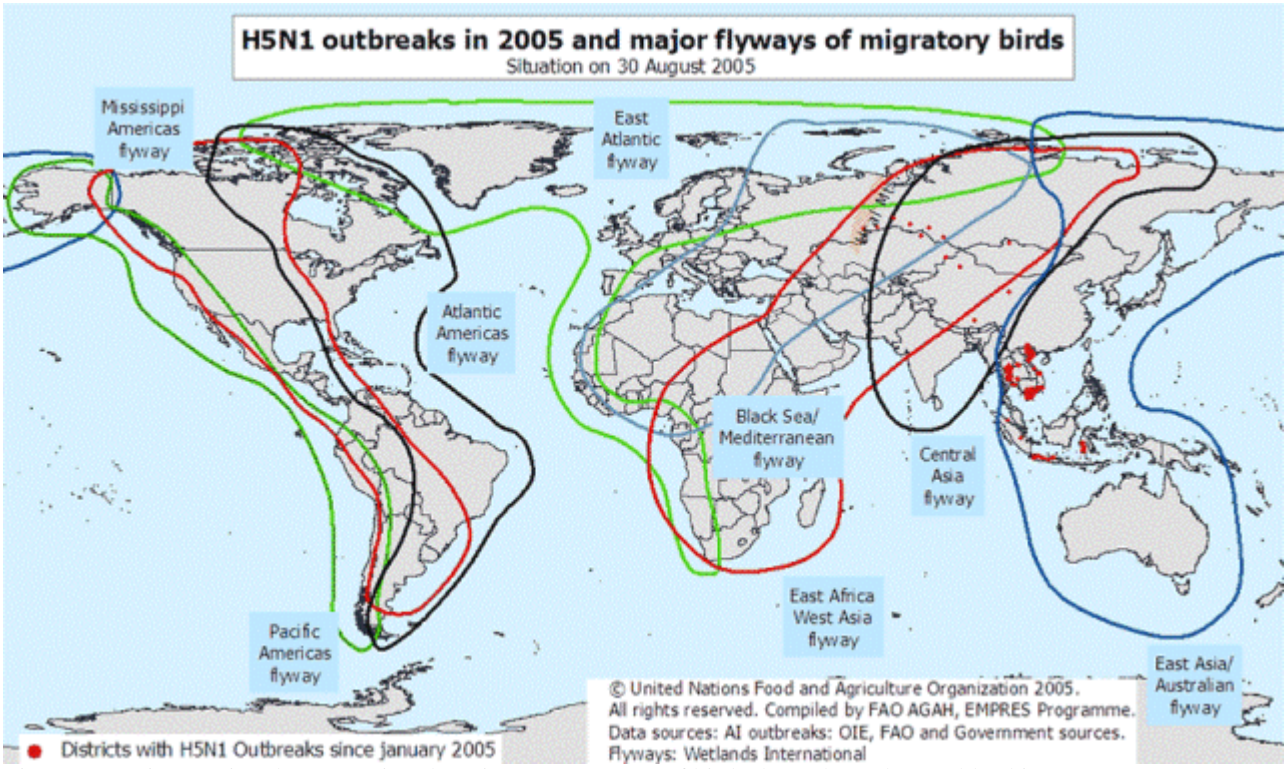

Figure 2: An international map tracing the migratory patterns of birds throughout the world. This demonstrates the interconnectedness of the migratory patterns and the increased probability that the virus will be passed on to birds and brought to all areas of the world.

Currently, the virus has migrated from China to Russia and infected poultry in Siberia. The same thing has happened in Kazakhstan, Mongolia, and Tibet. From there,

the virus has moved relentlessly, infecting chickens and wild birds to the west in Chelyabinsk, a city in the Ural Mountains, which is the final geographic barrier between Asia and Europe. In the northern hemisphere, it has reached as close as Canada, and will soon reach Africa. The rapid appearance of the virus in such different and distant regions has caused alarm throughout the international community. Environmental factors such as the migratory patterns of wild birds throughout the world are being considered closely. It may provide scientists with an outlook in which to better determine where the virus will appear next. This may aid in their attempt to be prepared for the spread of the virus and their attempts to contain it.

The other major global environmental issue that plays a large role in the advancement of the H5N1 avian influenza virus is globalization. Globalization can be defined as the increasing integration of countries. It is a term that is mostly applied to the economic integration of countries around the world. In this case, globalization is used to describe the integration of countries around the world in terms of the ease in which individuals from any country can travel to different areas of another country. Through globalization, the progression of the H5N1 avian influenza virus may move through the world at a pace faster than scientists can anticipate, and also in which technology and research cannot possibly keep up with. Globalization will give the H5N1 avian influenza virus an opportunity to travel to various parts of the world without impediment.

One of the main concerns involving the spread of the H5N1 avian influenza virus and globalization is how human to human contraction is going to be affected once the virus has gained the ability to spread easily from human to human. Once it has developed the ability to spread easily from human to human, the major concern becomes the travel

of individuals around the world, particularly air travel. Through air travel, an infected individual could infect dozens of people during their movement, those newly infected individuals would in turn, infect dozens more, and so on and so forth. Despite modern commercial aircrafts having filtration programs that limit the chance of a passenger transmitting the disease farther then a few rows, air travel still presents a larger problem in the progression of the disease. In one day, flying from a city such as Hong Kong, travelers could carry the virus to every corner of the world, infecting people in airports, hotels and other crowded places. Globalization will be a monumental factor in the spread of the H5N1 avian influenza virus when it is able to be easily transmitted from human to human.

Possible Prevention Policies:

The international community has been frantically attempting to develop plans and contingencies to prevent or stall the advancement of the H5N1 avian influenza virus. Currently, there is no commercially available vaccine to protect humans against the H5N1 virus that is being seen in Asia and Europe. However, vaccine development efforts are taking place. Another course of action being evaluated is plan of distribution of a vaccine to both animals as well as humans when an effective vaccine is developed. The issue of developing an effective vaccine for both animals and humans is posing to be a difficult task for scientists. This is due to the rapid physicochemical changes the virus undergoes in a relatively short time period. Thus causing the virus to mutate faster and become resistant quicker to any of the vaccines that can be developed.

In dealing with developing a vaccine for birds in order to prevent further infection of birds around the world, that problem has probably been more difficult for the scientists

than creating a human vaccine for the H5N1 avian influenza virus. This is due in majority to the actions taken by the Chinese government in attempting to prevent the spread of the virus to otherwise healthy, viable poultry. Their measures included injecting healthy chickens with a combination of medications, including a human antiviral medicine and amantadine, which is an antiviral medication used to treat influenza A. By vaccinating their poultry in this manner, the Chinese government essentially gave the H5N1 avian influenza virus an opportunity to develop a new strain of itself that is resistant to those medications.

In late August of 2005, the United States announced that it has successfully tested a vaccine for humans, which drew a worldwide sigh of relief. But as soon as the success of the vaccine was broadcasted, so were the doubts of its competency. Questions arose debating the effectiveness of the vaccine, with scientists speculating that the vaccine could be deemed useless due to the virus already having mutated to a different form, resistant to the vaccine. So far, there is only one known medication that is somewhat effective in treating human cases of the H5N1 avian influenza virus, which is called Tamiflu. Tamiflu is not a vaccine for the H5N1 virus; however it is an expensive antiviral medication that has a limited effectiveness against the H5N1 virus. Despite the limited effectiveness of Tamiflu, another problem of this medication is that there has been such a demand for it that there is no way to know if enough of the antiviral will be made in time to stall the pandemic.

The synthesis of an effective vaccine is one issue, but the prompt production of such a vaccine is another topic entirely. The mass production of a vaccine internationally proves to be a daunting challenge for pharmaceutical companies. Another dilemma would

be the cost of production of the vaccine. It would not be possible for third world countries such as Vietnam to afford enough vaccine for the population of the entire nation.

Another point of contention with the plans for the prevention of a pandemic is the ability of distribution of an effective vaccine to the individuals of the world that are most susceptible to the H5N1 avian influenza virus. Computer modelers have devised rapid-action containment plans that are operative if implemented within 48 hours of the reported outbreak. The problem with these rapid-action containment plans is that they do not take into account the accessibility of the location of each outbreak. For instance, if an outbreak occurred in rural Vietnam, the containment plan could not be implemented due to the lack of paved roads in order for the authorities to arrive to the area within the time frame allotted. Therefore, despite the best intentions of computer modelers, reality does not work in their favor.

Conclusions:

With the potential onslaught of the H5N1 avian influenza virus on the human population, the impact on multiple factors of life is going to be countless. This virus is speculated to be more destructive than the great influenza pandemic of 1918, which killed 50 million to 100 million people in a world that is one-third as populated as it is today. The transmission of this virus from person to person will have severe consequences for the world's political, economic, and almost all other aspects of life for humans.

When the H5N1 avian influenza virus steps into the realm of being a full-fledged pandemic, the implications would be limitless in terms of how the different facets of human life would be changed. Literally tens of millions of people, if not more people would die from this illness. Politically, it could completely change the international

landscape in many ways. There would be chaos, Third World regimes would fall, armies would be brought to their knees, security and police forces would flounder at a loss of what to do. Government officials would stand helpless, powerless to help their constituents. Economically, retail sales would plummet, stock and housing markets would collapse. Everywhere in the world, bodies would stack up unburied and hospitals would be filled beyond capacity with the dead and dying. Many scientists agree that this pandemic is imminent and the issue is not if, but when the H5N1 avian influenza virus will be able to be easily transmitted from person to person.

The attempts made by the World Health Organization have been providing a stall in the spread of the virus for the past few months. However, with the seasons changing and the birds of the world beginning their migration around the globe, the H5N1 avian influenza virus cannot be held back any longer. Their efforts in trying to evaluate and monitor the progress of this virus have met many obstacles. For example, the Chinese government has been obstructing the progress of World Health Organization officials in tracking the virus within the country. In addition to that, the Chinese government has also been concealing the number of outbreaks and reported human infections from the international community.

Besides political bureaucracy, there have been other factors that have stilted the World Health Organization's venture to determine the trajectory of the H5N1 avian influenza virus; social factors have played a role in creating barriers. For instance, cultural clashes between Vietnamese farmers and Western virologists are immense. In Vietnam, autopsies violate religious beliefs, and possibly infected H5N1 virus victims are

often cremated before samples can be taken, thus causing major hurdles in tracking the disease's movement and progression.

The environmental considerations and implications of this virus can be devastating to the animal population around the world. Although this virus is currently only predominant in birds it has been known to spread to other animals. Some of the species that have been reported to be affected by the H5N1 avian influenza virus so far, besides wild and domesticated birds, have been pigs, dogs, and cats. If the H5N1 influenza virus can make the final jump into humans, it is possible that it could also make the jump to affect a majority of the world's mammals. This would most likely include domesticated animals and livestock, which could possibly increase the human rate of infection.

Another environmental issue that needs to be taken into account would be the large-scale decimation of the world's domesticated poultry population. Since the outbreak of this virus, governments have been ordering the mass elimination of the source, millions of chickens and ducks. The continued eradication of the domesticated bird population may lead to serious environmental, not to mention economical consequences. This proves to be an illogical approach to controlling the outbreaks and spread of the H5N1 virus. In the majority of the countries affected most heavily by this disease, such as Vietnam, the livelihood of their citizens depends on their domesticated poultry. The mass decimation of domesticated poultry would be the same as destroying and possibly ending the lives of the individuals in danger of the virus themselves. The decimation is not a possible solution in terms of controlling the outbreaks as well as in the humanitarian sense. It is unreasonable to ask the people of third world countries to

bury their food, which is essentially what we are asking of them if we choose to decimate large masses of domesticated poultry.

Finally, the H5N1 avian influenza virus is an unavoidable threat that affects the international community, not only in terms of the human race, but the world's animal population as well. The physicochemical factors as well as environmental factors have allowed this virus to become an impending danger. As seen in the country of Vietnam, where the people have been hit the hardest, there seems to be no stopping of this pandemic. With Vietnam being used as a microcosm of what is to come, there are too many obstacles in which scientists must overcome, some of which include bureaucracy issues, cultural and social clashes, and many others.

As of recent weeks, the number of confirmed human deaths from the H5N1 avian influenza virus has rose to 135 confirmed cases of infection and of those cases, 69 deaths due to the virus. It can be clearly seen that this virus is not something that will go away and it demands the attention of not only international scientists, but the leaders of the world as well. It is only with the full cooperation on the parts of the governments of the world, and also the allied forces of the world's scientists and environmentalists that a plan may be devised in which to alleviate the effects of this imminent pandemic and hopefully, lessen the severity of the virus' impact on the human and animal populations.

Date of onset	**Cambodia**		**China**		**Indonesia**		**Thailand**		**Viet Nam**		**Total**	
	cases	**deaths**	**cases**	**deaths**	**cases**	**deaths**	**cases**	**deaths**	**cases**	**deaths**	**cases**	**deaths**
26.12.03-10.03.04	0	0	0	0	0	0	12	8	23	16	35	24
19.07.04-08.10.04	0	0	0	0	0	0	5	4	4	4	9	8
16.12.04-to date	4	4	4	2	13	8	4	1	66	22	91	37

Total	4	4	4	2	13	8	21	13	93	42	135	69

Figure 3: Cumulative Number of Confirmed Human Cases of Avian Influenza A (H5N1) Reported to World Health Organization since December 7, 2005

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