The Global Avian Influenza Network for Surveillance (GAINS)

Program Design and Organizational Plan and Analysis

Workshop Final Report

Report Task Team**: Brook Jackson, Katie King, Becca Pass** (Manager), **Jonathon Philipsborn** (Deputy Manager)**, and Meghan Schloat**

Task Team Members**: Nina Kishore, Matt Klasen, Vanessa Pena, Leyla Pourarkin, Jeffrey Smith, and Melissa Wright**

Submitted December 6, 2006
To Professor Kathy Callahan, Faculty Advisor

Acknowledgments

The Avian Influenza Surveillance Network task team would like to extend our thanks to Professor Kathy Callahan for her guidance, patience and genuine enthusiasm throughout this fall semester. Our ability to analyze policy and integrate our understanding of the science and legislation into a pragmatic program design was facilitated by her dedication and expertise. We would also like to extend another, continued thank you to Dr. Bob Cook for instilling the critical understanding of the integral and complex scientific issues surrounding the avian influenza problem. Thanks also to Professors Steven Cohen, Andrea Schmitz and Gary Weiskopf for their assistance, and to our colleagues for their support throughout the past two semesters.

Table of Contents

EXECUTIVE SUMMARY

In 1918, the Spanish Influenza pandemic killed an estimated 40-50 million people worldwide.[1] The influenza killed approximately three to five percent of the world's total population and infected 20 percent.[2] This pandemic has since been identified as a strain of avian influenza (AI), or an influenza virus that originates in birds and mutates into a form capable of human-to-human transmission. Other pandemics derived from avian influenza occurred in 1957 and 1968, which took six to eight months for the virus to spread around the globe.[3] Today's highly pathogenic strain of avian influenza, known as H5N1, re-emerged in 2003 and has rapidly spread from Southeast Asia to the Middle East, Africa, and Eastern, Western and Northern Europe, killing more than 100 million birds.[4] The World Health Organization (WHO) has confirmed more than 200 human infections from avian influenza, and its studies indicate that the H5N1 strain could spread within our interconnected world within only three months.[5] Though avian influenza is customarily a disease of birds, it has been intensely monitored and researched over the past few years due to its potential to mutate into a human pandemic as well as potential to cause immense economic and social damage to the world poultry market.[6]

Despite the severity of the threat, researchers are still uncertain as to how avian influenza is spreading and how it will ultimately affect economic, social, and environmental dimensions. Though efforts to protect human and domestic animal health are underway, efforts to research the role of and impact on wild birds, and predicts future outbreaks, is limited. A proposed legislative framework for this research, the Global Network for Avian Influenza Surveillance (GNAIS) Act, was introduced in the United States as an international effort to monitor the movement of wild birds and determine how it affects the mutation and spread of avian pathogens.[7] Data compiled through sample collection will be available through the database and will be used to create predictive models to anticipate the spread of the virus into new geographic locations.[8] The Global Avian Influenza Network for Surveillance (GAINS), implemented from the original GNAIS framework, has been granted $5 million from the U.S. Agency for International Development (USAID) and $1 million from the Center for Disease Control and Prevention (CDC) to be disbursed over a two-year period.[9] GAINS is currently in its planning stages, and so our task group has designed an original program that complies with the legislative framework and GAINS goals while respecting its financial and temporal constraints.

We have been addressing the problem of avian influenza throughout the past two semesters in our workshop course in Columbia's MPA Program in Environmental Science and Policy. We have analyzed the problem in great detail, including the scientific and environmental context, legislative solution, and policy context in order to design a pragmatic and viable program design. Our program design for GAINS aims to steer the global community's approach to avian influenza as an innovative and proactive network to monitor migratory movements and viral changes among wild birds. On a larger scale, we hope our organization will lend itself to the effective compilation of information to build predictive disease models and enhance global pandemic preparedness.

1.0 Introduction

Recently, a Highly Pathogenic Avian Influenza strain of avian influenza (HPAI), H5N1, has been associated with the deaths of chickens, wild birds, and mammalian species - including humans – in Asia, Africa, and Europe.[10] Avian influenza viruses primarily affect birds, but certain strains of these bird viruses can become infectious to other species including pigs, cats, and humans.[11] Already, the World Health Organization (WHO) has confirmed that there have been more than 200 cases of human infection and more than 100 deaths due to direct contact with domestic poultry carrying the H5N1 strain.[12] Given the proper series of viral changes, avian influenza could adapt into a virus that is capable of spreading from human to human. If this change occurs, the result could be a large-scale human pandemic.

Scientists and health experts have been monitoring the spread of the H5N1 strain since it was identified in the Guangdong Province of China in 1996.[13] The first human infections were identified in 1997 when 18 people in Hong Kong became sick and six died.[14] Cases of H5N1 outbreaks appeared again over a larger geographic area in mid-2003. From late 2003 to 2004, more than 100 million birds in Southeast Asia either died from disease or were killed in order to control the outbreaks.[15] Since early 2006, there have been cases of H5N1 in domestic poultry and wild birds in Africa and the Near East, see Figure 1. According to the WHO, the H5N1 virus has caused the largest outbreaks in domestic poultry on record since avian influenza viruses were first identified.[16] Uncertainties surrounding this virus are vast, and understanding these uncertainties is crucial for planning for the possible detrimental impacts it may have.

HPAI in wild birds has become a concern throughout the international community. Avian influenza has a history of affecting human health in immense proportions as a pandemic. The virus is capable of adapting its ability to infect different organisms as well as the nature and severity of the infection. It is unknown exactly how this virus is spread, how it will mutate, and what effects it will ultimately have on the global, national, regional and local levels. More research is needed to determine and understand avian influenza, its mechanisms of transmission and geographic dispersal, and its potential impacts. The international community lacks a sufficient mechanism to gather data and monitor the spread and evolution of avian influenzas in a coordinated manner.

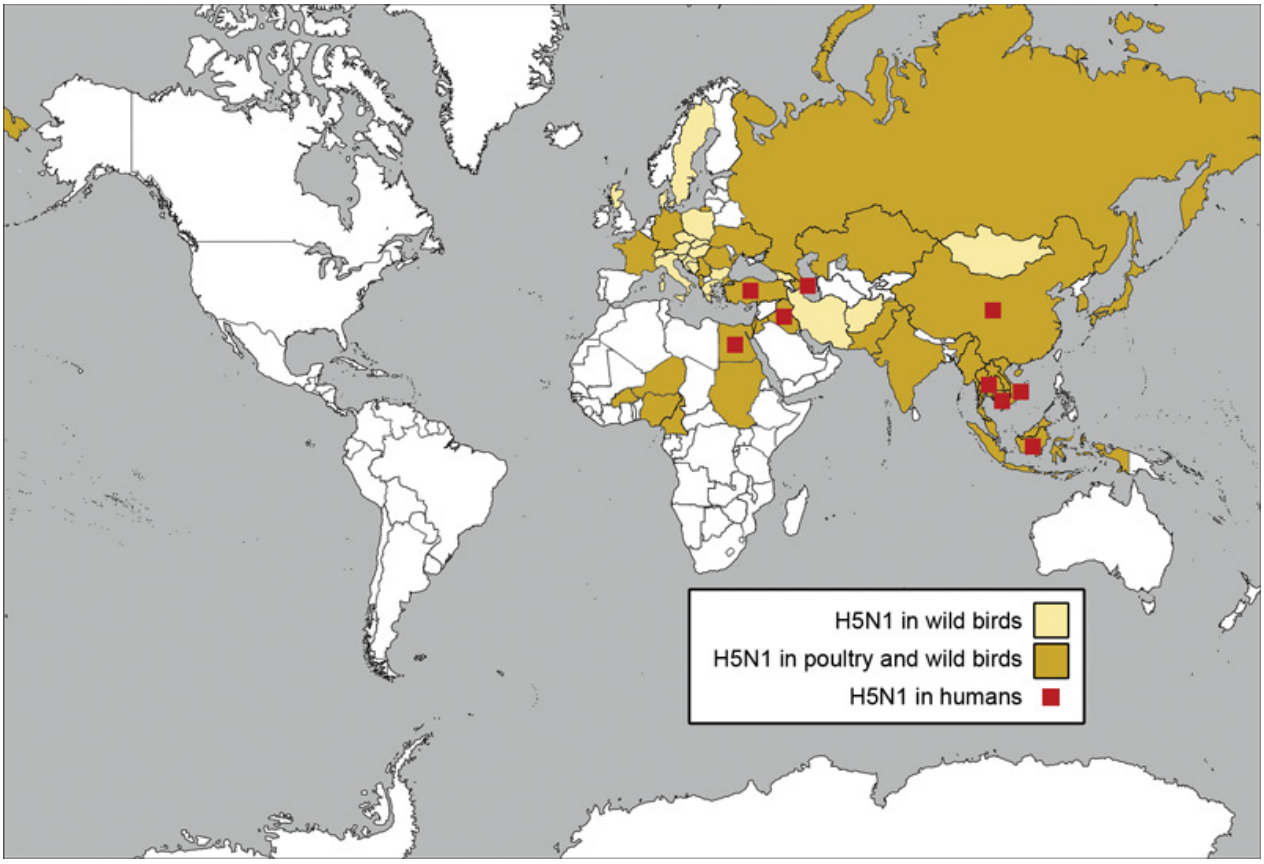


Figure 1. Nations with confirmed cases of H5N1 avian influenza, as of July 7, 2006.
Figure from HHS 2006 (www.pandemicflu.gov)

2.0 Scientific and Environmental History of Avian Influenza

The key to understanding AI spread and transmission is to understand the characteristics of the virus itself.

Virology of Avian Influenza

Avian influenzas are flu-like viruses, or pieces of genetic material surrounded by a protective protein coat. A virus can only replicate by infecting a host cell and using the cell machinery of the hosts to copy itself.[17] It binds to target cells and then releases copies of itself from host cells using proteins on its outer cell wall. These proteins are denoted by letters, which are used to classify different AI viruses, and scientists have found the H5 and H7 sub-types to be most likely to mutate and cause a deadly human pandemic.[18] The potential mutability of H5N1 is one reason that it has become a major focus of policymakers and the public.

Avian influenza exists in both low- and high-pathogenic forms. *Pathogenicity* refers to both the virus's ability to harm its host, and its capacity to spread among species.[19] HPAI is frequently fatal to domestic poultry and has caused death in wild birds due to its transmissibility between species .[20] Avian influenza can spread within a group of birds known as its *reservoir*. A reservoir population carries and assists in transmission of the pathogen without being harmed by it. Migratory birds or waterfowl may act as reservoirs for H5N1, spreading the virus through trade or along their migratory routes.[21]

Avian Influenza – Mechanisms of Spread

Two major mechanisms may be responsible for the geographic spread of avian influenza: wild bird migration, and trade. Wild bird migration has the potential to carry the virus along migratory pathways. Local, national and international trade of domestic and wild birds may also transmit avian viruses around the globe.

Migratory birds typically migrate twice a year, following warmer weather north during the Northern Hemisphere summer, and south during the Northern Hemisphere winter as shown in Figure 2.[22] What is of particular interest in studying the spread of avian influenza through wild bird migration is that these flyways often overlap in polar continental areas. Despite the fact that most migrations occur longitudinally, the overlap between migratory routes in these regions may permit

viral transmission in a latitudinal direction as well. High concentrations of migratory bird species also occur at natural hotspots at intermediate locations along migratory routes. These are commonly referred to as Important Bird Areas, or IBAs.

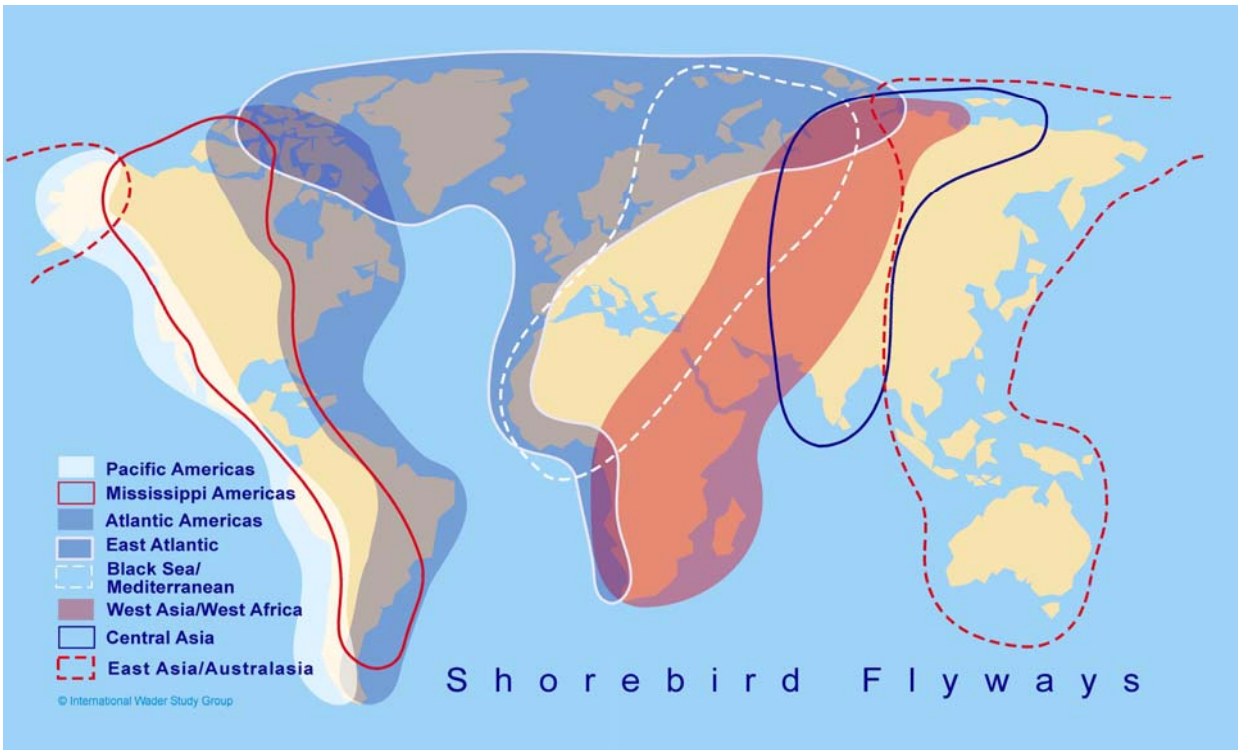


Figure 2: Suspected Shorebird Flyway Map
Figure Source: Pandemic Flu (http://web.uct.ac.za/depts/stats/adu/wsg/images/flyways0.jpg)

Birds migrate along bodies of water due to their resource needs. Stops along the migration pathways present opportunities for wild birds to come in contact with and mingle with domestic birds, particularly in developing countries where many households keep domestic birds for pets or for food and the birds often roam without restriction. If the wild birds carry LPAI, they may spread the disease to domestic fowl that share a pond or a source of water with them along their route. The interface of domestic and wild birds around bodies of water is significant because all known AI strains, both low-pathogenic and HPAI forms, have adapted the ability to exist and spread within water.[23] The virus can be contracted from feces, nasal secretions, saliva, blood, and contaminated water bodies, making potential viral spread within a close community of birds high.[24]

After contracting a low-pathogenic strain, an infected domestic bird will return to its traditionally confined quarters shared with many other birds. Such high poultry densities create

environments conducive to stress and viral transfer between birds, increasing the probability of LPAI mutation in the domestic bird into an HPAI form.[25] Once a bird contracts HPAI, the virus may infect nearby domestic birds, and potentially spread to wild bird populations. An HPAI strain has the ability to cause rapid infection and almost certain death within domestic and wild bird populations.[26]

A concern of avian influenza spread is its potential to cause death in currently threatened bird species, and thus have a negative impact on greater ecosystem biodiversity. Populations already low in numbers that contract HPAI would be at a much higher risk of extinction than healthy populations. Threatened species thought by some to be at high risk of extinction from avian influenzas include the lesser white-fronted goose, red-breasted goose, swan goose, oriental stork, Siberian crane and bar-headed goose.[27] The possible loss of an entire species, whether already threatened or not, provides incentive for researchers to conduct surveillance and understand and hopefully contain the disease.

The second possible mechanism driving the global spread of H5N1 is the trade of wild and domestic birds.[28] The movement of domestic and wild birds occurs on a global scale through both legal and illegal trade. Legal trade of domestic poultry is carried out through local auctions and markets, farms, wholesalers, and multinational corporations. In Southeast Asia, where H5N1 resurfaced, live markets are a feature of local culture. However, these markets bring together a large quantity of birds in often unsanitary conditions that are conducive to the spread of disease. Illegal trade of pets, wildlife products, and bush meat is also significant. Avian diseases may potentially spread from countries with lax regulatory or detection standards to previously disease-free areas through shipments of birds or bird products. The implications of trade as a potential mechanism for H5N1 spread are uncertain, but may require a complex, integrated response that addresses disease risks, economic concerns, and cultural norms. This issue will be further discussed in Section 4 below.

Improved disease detection and wildlife surveillance is the primary reason for promoting the GNAIS Act.[29] Scientist and policy makers do not know how avian influenza spreads, how wild birds and migration are involved in this spread nor how the virus changes.[30] GAINS will help answer these questions, fill information gaps and address uncertainties. The program will add to scientific understanding of avian disease through additional field research, sample analysis, international collaboration, and data sharing.

3.0 LEGISLATION SUMMARY

The Global Network for Avian Influenza Surveillance (GNAIS) Act (S. 1912/H.R. 4476) was proposed in order to better understand avian influenza epidemiology by examining the migratory patterns of wild birds and monitoring disease mutations.[31] The Secretary of Health and Human Services ("Secretary"), in conjunction with the Influenza Branch of the Centers for Disease Control and Prevention (CDC) will appoint a United States non-governmental organization (NGO) to work with various federal and non-federal partners to train contributing actors to test and survey wild birds for avian influenzas. Samples acquired at global important bird areas (IBAs) and international wild bird markets will be analyzed at certified laboratories used by Network partners.[32] Geographically referenced information on wild bird migratory patterns and avian influenza strains will be entered into an online database, which will provide global predictive capabilities.

Main Legislative Components:

As proposed, the surveillance program would incorporate monitoring and sample collection, field research and training, laboratory testing and data analysis, and international information-sharing via an accessible online database. We divide the legislative framework into four primary components: Partners, Training, Collection, and Database Management.

Partners. Upon enactment, the Secretary will collaborate with one or more approved wildlife conservation NGOs, which must have expertise in global wild bird health and conservation within the United States, and must currently manage accredited American zoological facilities. The Network heads would partner with federal agencies, international entities and additional NGOs to collect data, identify monitoring needs, and create a surveillance unit. Through these strategic partnerships, the Network builds on wildlife-disease expertise already held by existing institutions, and can more easily undertake training and research activities in order to better understand the dynamics of avian diseases. Details regarding GNAIS components required in the legislation are detailed in **Table 1.**

Training. The Secretary will mandate training and capacity-building activities in affected areas to be run by Network partners. Relevant monitoring and testing strategies will be taught to

participants by the partners and accredited veterinary colleges to increase base knowledge and promote long-term wildlife studies. Training of members is essential in keeping a level of consistency in data collecting, sample transportation, and laboratory analysis. Network Partnerships allow for ease of communication and follow-through in foreign countries.

Collection. Trained Network partners will test wild migratory and resident waterfowl for relevant strains of avian influenza and other avian diseases of potential global significance within IBAs and high-traffic trade zones. Partners will develop best practice protocols for collection and testing, and samples will be analyzed by certified laboratories meeting international standards. The development of protocols for collecting samples and transferring data is a way for GAINS to utilize its expertise on wild birds and partner relationships abroad.

Database. The database is the central innovation in the program design that allows for the Network to collect and contribute information on disease and wild bird movements in a novel way. Network-collected data are to be managed through a centralized database accessible to all interested governments, agencies, and individuals. This database will include the results of laboratory analyses and information on the geography and dynamics of wild bird populations in order to enhance comprehension of disease spread. Such information will improve the predictive capacity of health policymakers and wildlife conservationists.

Table 1. Descriptions of functional units of the proposed GAINS organization.

Functional Units			
Department/Unit	**Objective**	**Main Function**	**Staffing**
Training	Ensure that protocols and standard practices are observed in performing the Program's tasks	Train non-GAINS members (volunteers, partners' staff, laboratory scientists)	Majority of Staff are GAINS employees
Collection	Maximize bird sampling and ensure accurate testing given the finite unit resources	Perform standardized and uniform sampling, collection, and testing at regional laboratories	Diversified unit comprised of GAINS, Partners', and Volunteering Staff
Database	Compile a manageable and accessible set of data	Input laboratory test results into a centralized database	Primarily GAINS employees in regional/headquart

	that is accessible over the Internet		ers offices
Finance	Maximize output within budgetary constraints	Oversee GAINS/WCS budget, financial tracking/compliance & financial reporting	GAINS/WCS employees
Other Support Staff	Assist GAINS Program staff to promote effectiveness of the operation	Provide external or administrative services that can be performed by non-GAINS staff to increase utility of resources	Current NGO (WCS) employees to assist part-time with the GAINS staff

Legislative Timeline[33]

The evolution of the GAINS network is unique thus requiring a timeline to assist in the visualization of its progress from a piece of legislation to pre-implementation.

- **October 24th, 2005**- Senator Joe Lieberman [D-CT] first proposes S. 1912, the Global Network for Avian Influenza Surveillance (GNAIS) Act, which has remained in committee.
- **December 8th, 2005**- Representative Rosa DeLauro [D-CT] introduces an identical bill, H.R. 4476, into the House of Representatives, which similarly remains in committee.
- **December 16th, 2005**- GNAIS legislative text becomes a part of H.R. 4603, the Pandemic and Seasonal Influenza Act of 2005, introduced by Representative Nita Lowey [D-NY]. Again, the legislation remains in committee.
- **December 30th, 2005**[34] - Funding for domestic and international avian-influenza pandemic response efforts is passed by Congress and signed by President George W. Bush, as part of H.R. 2863, the Department of Defense, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico, and Pandemic Influenza Act, originally introduced by Rep. Bill Young (R-FL).
- **June 8th, 2006**[35] - Although the GNAIS framework was not yet enacted, USAID – using appropriations authorized by H.R. 2863 – awards $5 million to support the development of a global network to track avian influenza, with the aim of monitoring the role of migratory birds called the Global Avian Influenza Network for Surveillance (GAINS). These funds are

available to the Network for a two-year period. CDC announces an additional $1 million in funding for the GAINS program.

The NGO chosen to lead the final program, GAINS, is part of the Wildlife Conservation Society (WCS), a New York-based NGO.[36] Within the GAINS framework, WCS has started structuring and coordinating a global surveillance network following the guidelines of the bill.[37] Some of WCS's designated national partners include the United States Geological Survey (USGS), U.S. Department of Agriculture (USDA), and the University of California, Davis's School of Veterinary Medicine.CITE Internationally, the main partners include the WHO, Food and Agricultural Organization (FAO), and World Organization for Animal Health (OIE); and international NGOs such as BirdLife International, Wetlands International and the World Conservation Union (IUCN).[38]

Despite CDC and USAID support, there are many other aspects in the political, economic and social realms that may act as potential hurdles to the nascent program's success. The following challenges were considered within our program design analysis in order to create a program with long-term potential.

4.0 DIMENSIONS OF AVIAN INFLUENZA

The political, economic and social dimensions of the disease may impede the potential success of this nascent program. Each of these components present difficulties in properly addressing global concerns of avian influenza. Our program design for GAINS considers potential obstacles and attempts to address them. Appointing an independent NGO and establishing partnerships with many international actors will help understand and address these different dimensions of avian influenza.[39]

Political

Avian Influenza has global political implications due to the fact that the disease crosses international boundaries. Currently, there is a lack of transparency and cooperation between countries, which leads to a lack of information, and misinformation, surrounding the disease.[40]

GAINS relies on the transparency of the nations involved. These nations must allow researchers to have access to the necessary information gathered on expeditions or provided by partner organizations. However, the countries involved are sovereign entities and therefore have the discretion to grant or deny entry into their country, as well as determine what information or samples may be removed. Governments may also stall the flow of information by refusing to cooperate. Reasons for resistance to information sharing are linked to cultural differences, international disputes between countries and fear of economic impacts.[41]

The implications of a country's lack of transparency are exemplified by a case that occurred in China in late 2002 regarding the outbreak of Sudden Acute Respiratory Syndrome (SARS). The first SARS cases occurred in China's southern Guangdong province in November 2002, but China would not allow disease experts from WHO to visit the area to conduct research.[42] It was not until April 2003 that WHO experts were finally admitted into Guangdong to collect viral specimens.[43] This exacerbated the spread of SARS, and WHO openly criticized China for its behavior, stating that due to lack of transparency, China facilitated the spread of the disease and put the rest of the world at risk.[44]

Economic

The potential financial repercussions from avian influenza at the local, national, and international level have the potential to be immense and crippling to the data gathering efforts. Presently, many governments are unprepared for the undertaking and expenditure that would result from an epidemic outbreak.[45] As a bird disease, avian influenza can have serious economic consequences. The impact of trade bans, loss of livelihood to local or small scale farmers and lack of indemnities (or compensation for lost products) may result in decreased GDP to the country affected.[46]

Examples of past economic ramifications resulting from evidence of avian influenza in isolated countries have been on the scale of hundreds of millions of dollars, with far-reaching impacts on both tourism and foreign investment.[47] It has been estimated that any widespread outbreak could have an enormous negative impact on the world economy.[48]

For example, the Netherlands is one of the world's leading exporters of eggs and poultry with an industry valued at $2.4 billion dollars a year.[49] After outbreaks of avian influenza were discovered there, the European Commission ordered a ban on all of the county's poultry, eggs and

fresh bird meat.[50] This trade ban lasted over three months, costing the Netherlands over $2.6 million per day.[51] This example highlights the devastating consequences to a country's economy that can arise from revealing information about avian influenza. The fear of economic loss results in countries being less inclined to disclose information regarding possible outbreaks.

Social

The social dimension of this disease is more difficult to understand and confront. Cultural and lifestyle practices may contribute to the proliferation of the disease and will have to be addressed to combat its spread.

The different cultural associations and relationships with poultry can be exemplified in the widespread acceptance of cockfighting in developing countries. Cockfighting is a common cultural occurrence in much of Southeast Asia during rituals, festivals, and the harvest season.[52] During this time, the owner of the rooster is generally in close contact with the bird, providing a higher probability of disease transmission.[53]

Curbing "risky" cultural behaviors would require a large shift in consciousness and require education programs throughout the world. Presently, the majority of the outbreaks have occurred in areas where cultural and farming practices exacerbate the likelihood of disease transmission. If Western countries attempt to change longstanding cultural practices, the implications may be contentious and produce a negative backlash to the GAINS initiative. If a well-designed global network is constructed, it may be able to overcome these existing hurdles.

5.0 PROGRAM DESIGN AND OPTIONS ANALYSIS

The original GNAIS legislation provided for discretionary program design within the four main components previously mentioned: Partners, Training, Collection, and Database. The possible program options address these components, and include detailed assessments of the strengths and weaknesses of each option with regards to overall feasibility. The final recommended program design is an original creation of our team to optimize resources, achieve primary legislative goals, and to overcome or circumvent potential challenges just discussed.

Option 1: The Emergency Approach

Rationale. Due to recent concerns that H5N1 is gaining greater potential to spread to other regions of the world,[54] such as North America, an immediate response approach has been designed. The Emergency Approach attempts to respond to an immediate threat of an H5N1 outbreak by gathering as much real-time data as possible.

Description. Creating a centralized organization of partners ensures rapid coordination of efforts on all fronts including training, collection and database implementation and management. Training will be dependent on partners with training programs already in place. Collection and laboratory analysis of bird samples for testing will focus on mortality events and IBAs. Raw data will be transcribed into the database system placing less emphasis on data analysis. Rather, data and analytical tools will be globally accessible in order for outside groups and individuals to attain information through their own efforts. The lead NGO will provide database management; however, partner organizations will be responsible for inputting and organizing raw data.

Weaknesses. Training protocols and collection expeditions will be based on existing partner procedures and will not allow for a specialized system to be developed. Important data, such as wild bird migration movements and potential viral mutations, will be lacking. This gap will take away from the predictive capacity of the database, a central and innovative GAINS purpose.

Option 2: The Sustainable Approach

Rationale. This option will create a global surveillance network that will become an institution and an efficient, long-term early-detection network. Collection will not just focus on HPAI H5N1, but rather will investigate all avian influenzas and other avian pathogens. The Sustainable Approach acquires high quality samples and data, provides analyses used for long-term research, and creates a network with predictive capabilities.

Description. NGOs will coordinate analyses and risk assessments at local, state, national and international levels. Training of network actors for extensive, long-term contributions is an aim of this approach, and will be done in collaboration with expert partners. Collection practices will ensure large amounts of information and samples are gathered using efficient, global sampling strategies in IBAs and areas of wild-bird mortality/morbidity, as well as regions with no current outbreaks. This option focuses on creating an early-warning detection system, supported by high quality data and proper database management. Our formula for a Sustainable Approach nurtures

extensive partner collaboration in order to benefit from sharing resources including expert knowledge in standardization of protocols, training, collection techniques, and database management. Here we would integrate feedback mechanisms focusing on quality and adaptability in long-run scenarios.

Weaknesses. Disparate partners may conflict with each other, thereby increasing communication time and blunders, decreasing efficiency, and compromising the rapid compilation of influenza information. Budgetary and time constraints may hinder realization of this option.

The Recommended Option: The Balanced Approach

After designing and evaluating options for a sound program design, we decided upon a Balanced Approach for the GAINS program. Our balanced approach aims to strategically integrate components of The Emergency Approach and The Sustainable Approach to fulfill program goals and maximize resources. Based on their existing relationships, extensive avian and wildlife disease expertise, we have chosen the Wildlife Conservation Society as our lead NGO. WCS will achieve GAINS' goals through the following mechanisms:

Extensive Partner Collaboration. WCS will develop partnerships, both nationally and internationally, with state and local actors. Emphasis will be placed on creating partnerships with local contributors worldwide. Partners will be chosen based on their capacities to develop and extend field teams and/or conduct certified viral diagnostics. WCS and partners will create forums and methods to ease communication and improve performance.

Launch of Training Program. Training methods will focus on building the capacity of local organizations, partners and labs. WCS and partners will launch a training program using a combination of established guidelines currently in place at expert organizations. The effectiveness of the training program will be measured WCS through audits and other performance measurement indicators.

Prioritized Collection Strategies. Samples will be collected from IBAs and regions associated with past and current outbreaks, and strategies will be prioritized for different areas. Protocols will dictate desired sample size necessary to make statistically valid conclusions and the use of standard procedures for sample analysis.

Efficient Data Entry and Real-Time Database. Individuals performing field work will assist in data entry by using computer equipment that will automatically integrate data and

share real-time information with laboratories and participants. The system will provide participants with access to analytical tools, and will eventually serve to inform the global community on the present status and predicted direction of avian influenza outbreaks.

The strengths of this system rely on WCS and Network partners collaborating to utilize established expertise and resources in creating efficient guidelines and protocols, in order to achieve goals and reduce costs. The establishment of a training program will help increase local partner capacity to investigate avian diseases by coordinating protocols and training actors. Collection focused in IBAs and areas where outbreaks have been reported will concentrate resources. The distribution and use of technological equipment to facilitate the sharing of information will help attain real-time data. This program encompasses a wide spectrum, where collaboration between partners may take more time than anticipated. Even when the training program has been established, it is possible that training procedures for sampling and testing already used at the regional, state, and local levels may be more effective.

Table 2: Summary of Option Descriptions for Option 1, Option 2, and Option 3

Components:	**Option 1 Emergency Approach**	**Option 2 Sustainable Approach**	**Option 3 Balanced Approach**
Partners	➢ Centralized lead NGO to coordinate organization of partners	➢ Decentralized partners	➢ Extensive partner collaboration and feedback
Training	➢ Limited training and distant learning ➢ Guidelines organized by lead NGO ➢ Training organized by partners	➢ Extensive training ➢ Launch of an official training program for avian influenza	➢ Launch of an official training program for avian influenza ➢ Collaboration of training guidelines for training, collection, and data
Collection	➢ Focus on HPAI H5N1 ➢ Geographically focused collection based on migratory potential ➢ Species focused	➢ Focus on all avian influenza viral strains ➢ Widespread collection ➢ Focus on all efficient collection strategies ➢ Focus on global geographic areas	➢ Focus on prioritized geographic areas with outbreaks and surrounding areas ➢ Focus on prioritized collection strategies ➢ Use of certified laboratories
Database	➢ Focus on input of raw data into the database instead of data analysis ➢ Include analytical tools	➢ Focus on database analysis and producing an effective early-warning system	➢ Efficient data entry ➢ Real-time data ➢ Transfer of knowledge

6.0 IMPLEMENTATION OF THE BALANCED APPROACH

Through our analysis of the Balanced Approach, GAINS has the flexibility to coordinate and focus existing efforts in strategic areas pertaining to avian influenza outlook. GAINS will rely heavily partners for existing knowledge and expertise as well as infrastructure. Initially, GAINS will establish communication channels and reporting structures with partners. Frequent communication and standardized reporting between actors will increase efficiency of the overall network. Feedback loops within the GAINS organization will allow for continuous performance improvement. GAINS' organizational structure and management plans will reflect the needs of this balanced approach.

GAINS will organize activities in training, collection and database functions in collaboration with Partners in order to minimize expenditures and maximize immediate results. GAINS will train individuals in standardized protocols to ensure uniform and quality data. Multiple collection strategies will ensure that key geographic areas are undergoing surveillance and that wild-bird species of interest are researched and protected. Network participants and interest groups will have access to the data and analytical tools. We feel that applying standard procedures across existing collection efforts and providing data access from all of these efforts will highlight our balanced approach and unify the global effort to combat avian influenza.

7.0 ORGANIZATIONAL STRUCTURE, STAFFING PLAN AND PROGRAM DESIGN

We are recommending implementation of the following organizational structure that we have created by using the GNAIS Legislation and the GAINS Program mission statement and objectives. GAINS will be led by the Wildlife Conservation Society (WCS). WCS is an ideal choice to spearhead the GAINS effort because of its existing relationships in key geographic locations and extensive wild bird and avian influenza expertise. The organizational plan depicted in Figure 3 below will effectively bridge the gap between what is known and what must be learned in order to implement GAINS effectively.

Proposed Organizational Framework

The GAINS organizational diagram depicted in Figure 3 was created by our workshop group to support the surveillance network needs and goals. The sections outlined in red are existing positions in the WCS (Finances, Human Resources, and Public Relations) while all other positions were created by our task team. The detailed descriptions for all GAINS personnel described below are located in Appendix I. We will discuss the benefits of this structure and analyze the impact of this design.

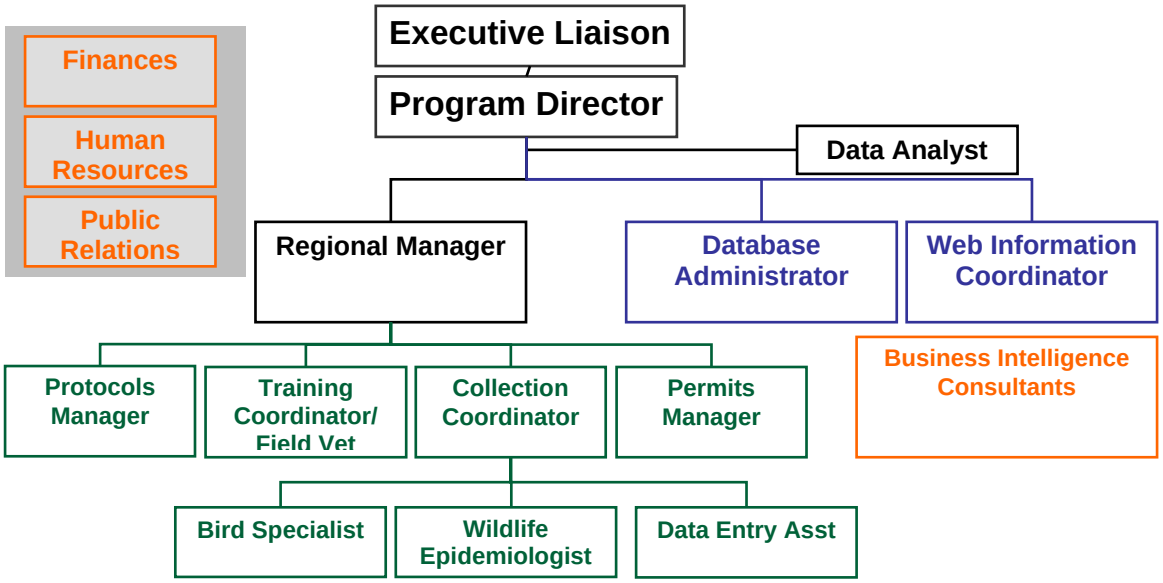


Figure 3: GAINS Organizational Structure

The Management Component includes the personnel who will lead GAINS and establish and facilitate communication with partner organizations. The WCS will establish three regional headquarters in New York City, USA; Paris, France, and Bangkok, Thailand. These locations have been chosen because they are close to partner resources, providing easy access to certified laboratories. New York City is home to WCS headquarters, and allows for collaboration with U.S. agencies to prevent outbreaks within North America. The Paris location is the headquarters for our Partner OIE, and is close to Northern Africa and all of Europe, areas on the periphery of current H5N1 outbreaks. Bangkok was chosen because it has one of the only OIE-certified labs in Southeast Asia, the area most affected by H5N1.

The centralized team in New York will coordinate the overall GAINS program. Positions in the New York office include the Executive Liaison and the Program Director. The Data Analyst, along with a support staff consisting of the Finance Coordinator, the Public Relations Coordinator, and the Human Resources Administrator, are also centrally located in this office. The latter three positions are existing WCS staff. All three of the regional headquarters will include staff dedicated to the core training and data-collection functions of the network. Each office is led by a Regional Manager who oversees a Manager of Protocols, a Manager of Permits, a Training Coordinator and a Collection Coordinator, and a Data Entry Assistant. The training and collection components in Paris and Bangkok will also be assisted by a Bird Specialist and a Wildlife Epidemiologist. Our final component involves the personnel working with the Database and its outputs. A Database Administrator will work with a Web Information Coordinator in New York City, and they will be constantly receiving data inputs from the Data Entry Assistants in the other regions. The DBA will also contract a Business Intelligence consulting firm to construct and launch the database system.

Table 2. Descriptions of functional units of the proposed GAINS organization.

Functional Units			
Department/Unit	**Objective**	**Main Function**	**Staffing**
Management	Direct GAINS activities to fulfill requirements of the grant and achieve GAINS mission	Oversee GAINS personnel and activities, establish and maintain strategic partnerships, communicate GAINS success, and update potential funders on GAINS activities	Exclusively GAINS full-time employees
Training	Ensure that protocols and standard practices are observed in performing the Program's tasks	Train non-GAINS members (volunteers, partners' staff, laboratory scientists)	Majority of Staff will be GAINS employees who work with partners to implement initial training program
Collection	To maximize bird sampling and accurate testing given the finite unit resources	Performing standardized and uniform sampling/collection of bird samples to be tested at regional laboratories	Diversified Unit comprised of GAINS, Partners', and Volunteering Staff
Database	Compiling a manageable and accessible set of data	Input laboratory test results into a centralized database	GAINS employees in regional/headquarters

	that is accessible over the Internet	and provide updates to Partners	offices and BI Consultants who will create and launch the database
Other Support Staff	Assisting with the GAINS Program staff to promote effectiveness of the operation	Varied by section to provide external or administrative services that can be performed by non-GAINS staff to increase utility of resources	Current NGO (WCS) employees that assist part-time with the GAINS staff

Benefits of the Organizational Structure

Our recommended structure maximizes limited GAINS resources and increases communication and cooperation amongst global partners to fulfill GAINS' mission. Internal measures share WCS staff to perform support functions, and external measures use the resources of our collaborative partners. The Executive Liaison, as the most senior member of this hierarchical structure, will serve as a spokesperson both with our partners, and with the United States government.

Master Calendar

Working with our created organizational structure, our master calendar outlines the activities and goals of the GAINS program for its first year. The Master Calendar follows our four main structural components derived from the GAINS program: management, training, collection, and database. In the first year, the management component will prioritize the hiring of staff and establish reporting mechanisms for staff and partners. Recruitment of personnel within GAINS will be coordinated in two stages: first, the top personnel such as the Executive Liaison, Program Director and Regional Managers; and second, lower-level officials hired by Regional Managers. The training component, in association with University of California-Davis (UC-Davis)'s Veterinary College, will develop broad training program goals, and create lesson plans and protocols for future training efforts. UC-Davis will conduct the GAINS "train-the-trainer" program, a one-month training of key GAINS staff, and a five-day on-location training program for international partners.[55] The collection component will research and compile existing data, locate gaps in this data, and coordinate collection efforts to address these gaps. Collection officials will also begin researching permit application processes for different expedition sites. Finally, the

database component will oversee the creation of the accessible internet database with business intelligence consultants, the compilation of data-entry protocols, and the input of data from GAINS field collection initiatives.

The Master Calendar, including detailed dates of GAINS activities, descriptions of each activity, and the justification for the timing and structuring of each particular task, is located in Appendix III.

Impact Analysis of Organizational and Staffing Plan

Due to the GAINS program being in an incipient phase of its implementation, a great deal of inference was used in order to create a recommended structure that would fulfill the objectives of the GAINS proposal while working within budgetary and time constraints. Our calendar addresses our need to provide information quickly. Our budget will seek to allocate money to each of our functional components to fulfill our first-year tasks.

By emphasizing training in the first year, the GAINS program reaches out to volunteers, universities, and Partners in order to teach them about the GAINS initiative and show them how they can contribute to these efforts. This training outreach will build capacity, extending GAINS influence and global undertaking beyond WCS and creating awareness at the regional, local and global level. More importantly, this will help GAINS achieve its goals despite a limited budget over a two-year time frame.

How Partners Benefit

Our strategy of integrating WCS and our partners into the GAINS network results in a mutually beneficial relationship. Partners will receive financial benefits from their association with the GAINS initiative, and partners' staff will receive training from both WCS and GAINS in order to alleviate some of the partners' personnel costs. As detailed below, partners may also participate in a matching-grants program, allowing a joint commitment of resources and a doubling of leveraged funds. Newly trained personnel from our partner organizations will be able to apply their increased skills to other existing projects involving wild bird surveillance, disease detection, or the avian influenza effort, which will benefit their program while supplying an incentive for

participation. In addition, partners will have access to GAINS data, which they can use to inform future research initiatives.

8.0 Budget Summary and Analysis

Total funding for the GAINS program is $6 million over two years, but the budget we present is only for the fiscal year 2008 (FY 08). 56% of the total funding will be spent in the first year. Our budget is front-loaded to cover the one-time startup costs of the database and the development of the training program. The line-item budget in Appendix III B shows the breakdown of the entire program by personnel and non- personnel services while the assumptions we made to create the budget are detailed in Appendix II A.

Personnel Costs are salaries based on WCS yearly wages for similar positions advertised within the organization. The financial, public relations (PR), and human resources (HR) positions already established within WCS are allotted a percent of Full-Time Equivalent (FTE). Fringe benefits are assumed to be 25% of salaries, as followed by CDC personnel budget templates. These costs are paid per position and include Social Security, health insurance, and workers' compensation.[56] We choose to allot 20% FTE for the financial, PR, and HR positions that will be funded by the GAINS program. Since we are using existing positions within WCS, we will minimize costs associated with salary administration..

Matching Grants Program

In order to create incentives for organizations to form partnerships with GAINS, the Financial Coordinator will create a Partner Matching Grants Program to support partner collection and training activities. Funds will be distributed throughout each of the three regions, and the Program Director will manage the specific allocation of these funds.

We create two separate matching grants funds. The Training Fund will allocate money to partner universities and institutions that are researching and working towards the training program initiative. The Collection Fund will provide grants to organizations that contribute to laboratory analysis and field work. For budgeting purposes, finances allocated to the Training Fund and Collection Fund will be included in the training and collection organizational units, respectively.

The total amount distributed through this grant matching program is $1,400,000.00: $750,000.00 for collection; $400,000.00 for Training, and $250,000.00 for Laboratory Analysis (See Appendix III B). Partners will match this amount with their own resources, enabling us to leverage a total of $4.7 million over the first year.

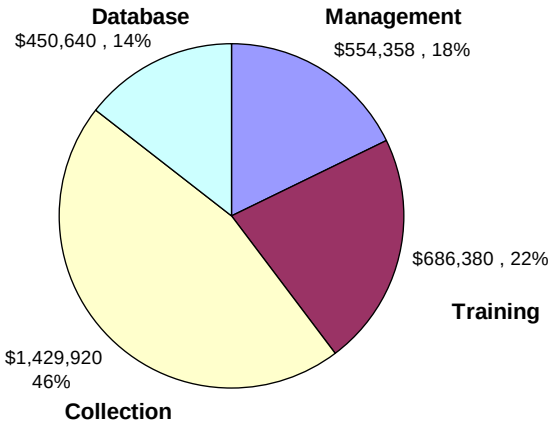
Prerequisites for organizations or universities to receive grants through Training Fund include having the capacity to formulate training programs and provide personnel, research capacity,[1] and cover the cost of materials and training supplies. They must have experience in avian research and infectious diseases, and must work with the Regional Training Coordinator to set up laboratory and field collection protocols.

Prerequisites for laboratories to receive grants through Collection Fund include the ability to provide laboratory and diagnostic testing analysis and space for regional offices. The prerequisites for organizations conducting field collection efforts include the ability to provide equipment and supplies for expeditions. Both laboratory and collection partners must have certifications and permits for conducting avian influenza analysis,[2] and bio-safety procedures for working with and disposing contaminated materials. They must also possess the capability to provide emergency testing and collection in case of major outbreaks. The flexibility of our matching grants program will give us the ability to prioritize sampling efforts and reallocate resources among the three regional offices in the case of unexpected outbreaks.

Our budget represents a balanced approach that emphasizes long-term sustainability of the GAINS database while incorporating the flexibility to respond to emergency situations such as major avian influenza outbreaks. Management has the discretion to revise the budget in the case of emergency situations in order to allocate more funds to training, collection, and lab analysis where and when necessary.

Figure 4: Funding allocation for GAINS by functional component

[1] Capacity may consist of student, faculty, and staff working towards the training program initiative.
[2] Laboratory certification can be provided through partner organizations: the FAO, WHO, CDC, or OIE.



9.0 Performance Measurement

In order to ensure that GAINS carries out the program design with in the confines of the budget and limited timeframe, it is essential to instill within our organization a system which monitors, manages and optimizes our internal performance. A system of this type serves as a guide to carry out GAINS' objectives in a timely and efficient manner. Given the major constraints of GAINS utilizing our resources to their fullest extent is crucial to the long-term success and perpetuation of the program. Performance measurement is important to monitor the achievement of both the short-term and long-term visions of GAINS. Our system to effectively manage GAINS performance can be broken down into four major components: measurement, compilation, reporting and feedback.

Measurement and Performance Indicators

In order to properly assess the performance of GAINS, we must first define what it is we are measuring. The measurement component is comprised of a series of metrics, which can be further subdivided according to the specific divisions of GAINS to which they apply. Each subdivision of the GAINS program will contain a number of both quantitative and qualitative metrics. A detailed list of these metrics with specific descriptions can be found in Appendix IV.

Compilation

The compilation component defines how performance measurement information is collected and centralized in one easily accessible location. Figure 2 in Appendix IV depicts the proposed flow for the centralization of GAINS performance indicators. Important aspects of the compilation component refer to who is collecting the information for each respective performance metric, how much information is collected at a time, and how often this process occurs.

The New York Regional Manager (NYRM) is responsible for centralizing and compiling all the information on GAINS performance metrics received from Paris and Bangkok Regional Managers, the Database Administrator, the Finance Coordinator, as well as from Partners. Because such information must be retrieved from various parts of the organization (see below Figure 6) it is important to have an organized and clearly defined information flow so that the NYRM can build performance metrics efficiently and conduct a comprehensive analysis of the performance metrics.

Furthermore, it is important to highlight the fact that both training and collection metrics (regional information) will be integrated in one same report sent to the NYRM twice a month. However, database and finance information as well as partner information will only be sent on a monthly basis. This two-tiered compilation process ensures that monitoring the performance of regional units remains a priority.

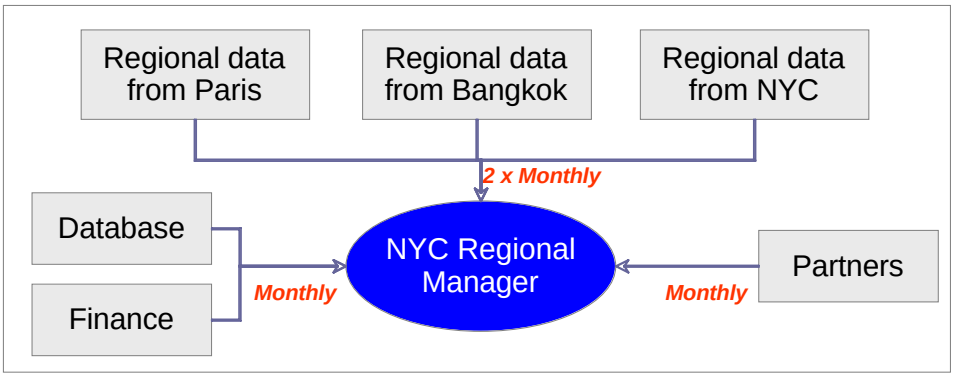
Reporting

After compiling the information obtained from the performance measures, it is essential to implement an effective and efficient system to transfer performance information to the Program Director, the Executive Liaison and, ultimately, GAINS partners. Reporting on the measures of success up the chain of command will work to streamline communication throughout the organization and facilitate the program's adaptation (See Figure 3 in Appendix IV). The flow of information will be a bottom-up process beginning within our three regions, and will ultimately result in the upper management sending feedback from the top down on how best to reinforce success or implement changes. This reporting system will allow all levels involved in the organization to follow and document the program's progress while maintaining sufficient communication between the regions and the New York office.

The Thailand and Paris Regional Managers will relay the accumulated information from their regions to the NYRM twice a month. The NYRM will analyze this information and compile a

report on the indicators of success from the different regions and prepare a comprehensive report for the Program Director and the Liaison on a monthly basis.

Figure 6: Flow of information for the compilation of performance measurement metrics



Feedback

The feedback component defines how performance measurement information will be used to modify the organizational structure and behavior of the program. Through the process of receiving both positive and negative feedback, we plan for GAINS to be able to incorporate mid-course corrections and optimize program performance. Once the Program Director receives the monthly performance management reports and has discussed any pertinent information with the Executive Liaison and partners, the downward transfer of feedback to the Regional Managers may commence. This information is essential for the Regional Managers to determine what is functioning well within their region and highlight the areas that need subsequent work. This information is then relayed to the training and collection coordinators as well as the managers in charge of protocols and permits. This will allow them to elaborate on and emphasize aspects within the program that seem effective and halt or mitigate practices that appear unsuccessful. Our team feels that paying close attention to the feedback regarding the organization's success and shortcomings will improve GAINS' flexibility and strategic direction.

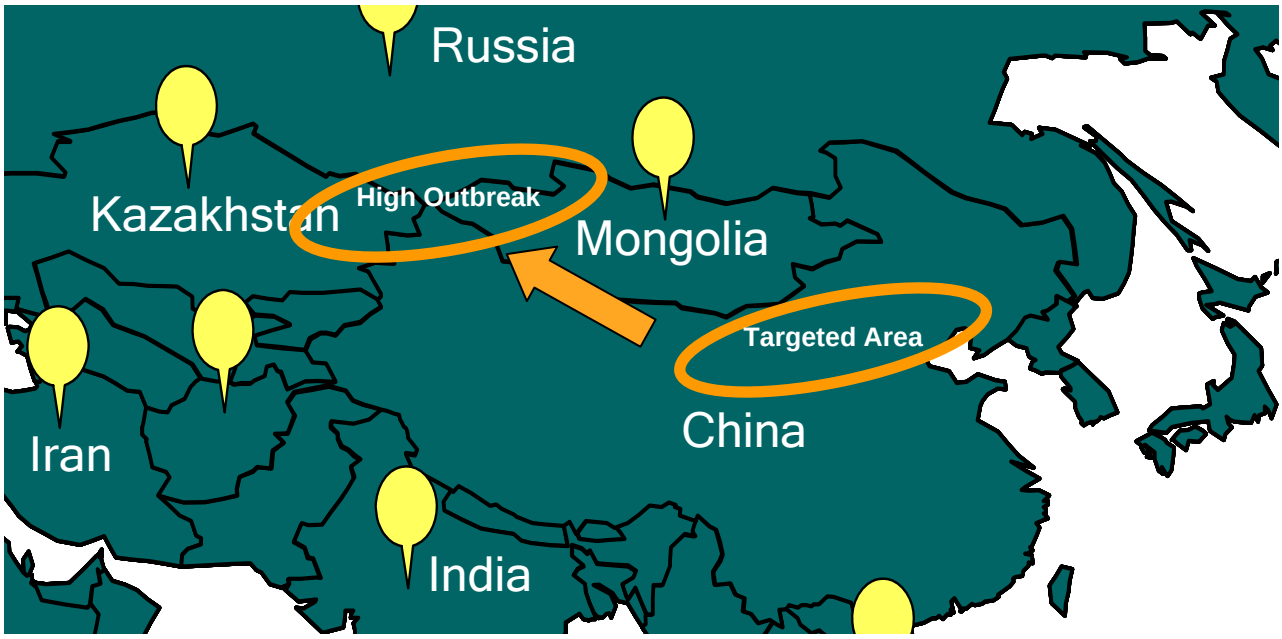


Figure 7. Map of Asia: Example of Performance Measurement Feedback System at Work. Resources originally directed along the China-Mongolia border may need to be shifted to northwestern Mongolia as new outbreak information emerges

Through the use of a feedback system, GAINS can examine data and measure performance information against target metrics; for instance, the number and location of samples collected in a particular region and the usable data derived from these samples. For example, a GAINS team in northeast China may choose to sample intensively in a particular area, where avian influenza outbreaks are frequent. However, if high bird morbidity is reported in another area (see Figure 7), GAINS must adjust its priorities and re-focus collection efforts as quickly and efficiently as possible. This specific example of re-focusing priorities highlights our program's flexibility, and its ability to shift focus and resources among collection areas, an essential component of GAINS' long-term success.

10.0 Contingency Plan

Avian influenza is a disease that is as dynamic as it is threatening. Its dynamic nature is exacerbated by its ability to mutate rapidly, and its potential pandemic capability. Therefore it is imperative to incorporate a contingency plan based on possible unforeseen emergency circumstances. We have built flexibility into all aspects of our program design in order for GAINS

to continue critical operations and assist the global wildlife and human health community. The definition of what an "emergency" is will change depending on local, global, and temporal circumstances. Examples of emergencies could include any change in avian viral strains that result in more effective human-to-human transmission, or any observed outbreaks of significantly higher case fatality rates in bird populations.

Program Budget Flexibility. Funding will be reallocated if there is a need for increased capacity in training and collection if an emergency situation were to arise. We will have the Network increase the number of partnerships by relaxing some of the partner selection criteria. In addition, collection initiatives will be amplified in areas of major outbreaks. This may require tapping into both the matching funds for partners, next year's budget, or requesting emergency allocations from the U.S. government. Partner matching funds will be accessible for this purpose because our matching-grant award cycle will be semi-annual. Therefore, WCS will not have to commit funds for the full fiscal year, but will be able to reallocate money if necessary.

Performance Measurement Flexibility. Availability and access to data in the case of an outbreak is a large indicator of program success for GAINS because it emphasizes the ability of the program to work and function in a variety of different scenarios. Maintaining a flexible program reporting design – helpful for tracking the changes in the virus and maintaining a high level of preparedness in the case of an outbreak – is imperative. In an emergency situation, data reports will go directly to the Program Director from the region on a daily basis, or as the Program Director sees fit.

Master Calendar. For information regarding scheduling and reporting changes resulting from an emergency situation, please see the Master Calendar in Appendix III.

11.0 Closing

The process of devising a hypothetical GAINS program provides our group with much insight into the design, structure and planning involved in a real life organization. Many assumptions have been made throughout the planning of our program development. Our priorities were established based on facts, as well as assumptions, about possible program designs while integrating the varying and uncertain science about the virus. Tracking breaking news and media coverage as well as

monitoring real-life GAINS implementation has been challenging and rewarding. Because new information is constantly accumulating on avian influenza it is impossible to predict the future of this disease. Having said this, we would like to offer our suggestions for a continued effort by the GAINS program for its innovative and proactive approach to the avian influenza problem.

At the end of the first year, the actual GAINS program should be effectively collecting and sharing information on wild bird movements, avian diseases, and how the two relate to each other. We believe that a continual re-evaluation of program organization, budget, and performance measurements will ensure that GAINS can effectively adapt to future challenges. By meeting our legislative mandate to construct a global network for avian influenza surveillance, we hope our structure could, if implemented, provide helpful predictive information to policymakers and the global community.

Bibliography

Policy Actions or Proposals

A Bill to Establish a Global Network for Avian Influenza Surveillance among Wild Birds Nationally and Internationally to Combat the Growing Threat of Bird Flu, and for Other Purposes. United States Senate. 109th Congress, 1st Session. S. 1912. 24 Oct. 2005.

A Bill to Establish a Global Network for Avian Influenza Surveillance among Wild Birds Nationally and Internationally to Combat the Growing Threat of Bird Flu, and for Other Purposes. U.S. House of Representatives. 109th Congress, 1st Session. H.R. 4476. 8 Dec. 2005.

Department of Defense Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico, and Pandemic Influenza Act, 2006. U.S. House of Representatives. 109th Congress, 1st Session. H.R. 2863. 21 Dec. 2005.

Food and Agricultural Organization. "Guiding Principles for Highly Pathogenic Avian Influenza Surveillance and Diagnostic Networks in Asia." FAO Expert Meeting on Surveillance and Diagnosis of Avian Influenza in Asia, Bangkok, 21-23 July 2004.

Salaam-Blyther, Tiaji. "U.S. And International Responses to the Global Spread of Avian Flu: Issues for Congress." Congressional Research Service, 2006.

U.S. Department of Agriculture. "Pandemic Planning Report." USDA Office of the Secretary, 29 June 2006. 13 Aug. 2006. <http://www.usda.gov/documents/PandemicPlanningReport180.pdf >.

U.S. Geological Survey. "National HPAI Early Detection Data System (HEDDS)." 5 Aug. 2006. <http://wildlifedisease.nbii.gov/aidemo/>.

U.S. Geological Survey. National Wildlife Health Center. "Field Manual: Avian Influenza." 2 Feb. 2006. 13 Aug. 2006. <http://www.nwhc.usgs.gov/publications/field_manual/chapter_22.pdf>.

U.S. Geological Survey. National Wildlife Health Center. "USDA, DOI, and HHS Expand Screening for Highly Pathogenic H5N1 Avian Influenza in Migratory Birds." Press Release. 20 March 2006. 13 Aug. 2006. <http://www.nwhc.usgs.gov/disease_information/avian_influenza/department_of_the_interior_-_H5N1_brief.jsp>.

World Health Organization. "Epidemic and Pandemic Alert Response." 9 Aug. 2006. <http://www.who.int/csr/disease/avian_influenza/country/cases_table_2006_08_09/en/index.html>.

Social and Economic Dimensions

Hall, Cheryl. "Impact of Avian Influenza on U.S. Poultry Trade Relations-2002: H5 or H7 Low Pathogenic Avian Influenza." Annual Rev. New York Academy of Sciences 1026 (2004): 47-53.

Uyeki, T. "Public Health Impact of Avian Influenza." Centers for Disease Control and Prevention. 3 Nov. 2004. 16 Aug. 2006. <http://www.cdc.gov/flu/pp/ ph_impact_avian_fl_11_2004.pdf>.

Convention on the Conservation of Migratory Species of Wild Animals. "Stop Ducking Hard Facts and Tough Policy Options on Bird Flu, Says New Scientific Task Force." Press Release. 24 Oct. 2005. 15 Aug. 2006. <http://www.cms.int/news/PRESS/nwPR2005/pressrelease_AvianFlu_final_24_10_05.pdf>.

Crosson, David. "Bird Ecologists Seek Global H5N1 Surveillance." Frontiers in Ecology and the Environment 3.10 (2005): 528

Doran, Peter, ed. "Early Warning Systems and Development of Risk Assessment Models." Avian Influenza and Wild Birds Bulletin 123.1 (2006): 1-8.

Fields, Bernard, et al., eds. *Field Virology*, 4th Ed. Boston: Harvard University Press, 2001.

Food and Agricultural Organization. "Wild Birds and Avian Influenza." 13 Aug. 2006. <http://www.fao.org/ag/againfo/ subjects/en/health/diseases-cards/ avian_HPAIrisk.html>.

"Hot Spots for Birders." 13 Aug. 2006. <http://www.birder.com/birding/hotspots/index.html>.

Karesh, William B., et al. "The Human-Animal Link." Foreign Affairs 84-4 (2005): 38.

Karesh, William B., et al. "Wildlife Trade and Global Disease Emergence." Emerging Infectious Diseases 11.7 (2005): 1000-1002.

Kuehn, Bridget M. "Animal-Human Diseases Targeted to Stop Pandemics Before They Start." Journal of the American Medical Association 295.17 (2006): 1987-1989.

Kuiken, T., et al. "Public Health: Pathogen Surveillance in Animals." Science 309.5741 (2005): 1680-81.

Mörner, T., et al. "Surveillance and Monitoring of Wildlife Diseases." OIE Review of Science and Technology 21.1 (2002): 67-76.

Normille, Dennis. "Are Wild Birds to Blame?" Science 310.5747 (2005): 426-428.

Normille, Dennis. "Evidence Points to Migratory Birds in H5N1 Spread." Science 311.5765 (2006): 1255.

Sims, L.D., et al. "Origin and Evolution of Highly Pathogenic H5N1 Avian Influenza in Asia." Veterinary Record 157.6 (2005): 159-164.

U.S. Centers for Disease Control and Prevention. http://www.pandemicflu.gov/

Van Borm, Steven., et al. "Highly Pathogenic H5N1 Influenza Virus in Smuggled Thai Eagles, Belgium." Emerging Infectious Diseases 11.5 (2005): 702-705.

World Health Organization. <http://www.who.int/csr/disease/avian_influenza/en/>

GAINS Sources

Karesh, Bill. Wildlife Conservation Society, Harvard Medical School. Powerpoint Presentation, (53-64). http://chge.med.harvard.edu/education/policy/domestic/course/concourse2006/documents/karesh_ppt.pdf

Porter, Charlene. "Asian Wild Bird Study To Provide Data on H5N1 Transmission." U.S. Department of State. 07 Sep 2006. <http://usinfo.state.gov/xarchives/display.html?p=washfileenglish&y=2006&m=September&x=20060907122117cmretrop0.4086878>

"Avian Influenza Response." USAID. Washington, D.C. 01 Sep 2006. http://www.usaid.gov/our_work/global_health/home/News/news_items/avian_influenza.html

"U.S. Launches International Partnership on Avian and Pandemic Influenza." State Department. Washington, D.C. 22 Sep 2005.

Delaney, John. "US Approves Global Avian Flu Surveillance Network." Wildlife Conservation Society. 9 June 2006.

"Updated situation of Highly Pathogenic Avian Influenza (H5N1) in Asia." Empres Watch. Aug 2006.

"An Early Detection System for Highly Pathogenic H5N1 Avian Influenza in Wild Migratory Birds: U.S. Interagency Strategic Plan." USDA. 14 March 2006.

Bunn, David. Phone interview. 2 November 2006.

Sandrock, Christian. Phone interview. 19 October 2006.

Notes

[1] U.S. Centers for Disease Control and Prevention. “Questions and Answers About Avian Influenza (Bird Flu) and Avian Influenza A (H5N1) Virus”, 19 May 2006. 7 September 2006. <http://www.bt.cdc.gov/scripts/emailprint/print.asp>.
[2] Unites States Census Bureau. “Historical Estimates of World Population”, 24 August 2006. 1 December 206. <http://www.census.gov/ipc/www/worldhis.html>.
[3] World Health Organization. “Ten Things You Need to Know About Pandemic Influenza, 14 October 2005.” 14 Oct. 2005. 9 September 2006. <http://www/who.int/crs/disease/influenza/pandemica10things/en/print.htm>.
[4] U.S. Centers for Disease Control and Prevention. “Questions and Answers about Avian Influenza (Bird Flu) and Avian Influenza A (H5N1) Virus. 19 May 2006. 9 September 2006. <http://www.bt.cdc.gov/scripts/emailprint/print.asp>.
[5] World Health Organization. “Ten Things You Need to Know About Pandemic Influenza, 14 October 2005.” 14 Oct. 2005. 6 June 2006. <http://www/who.int/crs/disease/influenza/pandemica10things/en/print.htm>.
[6] Salaam-Blyther, Tiaji. "U.S. And International Responses to the Global Spread of Avian Flu: Issues for Congress." Congressional Research Service, 2006.
[7] A Bill to Establish a Global Network for Avian Influenza Surveillance among Wild Birds Nationally and Internationally to Combat the Growing Threat of Bird Flu, and for Other Purposes. United States Senate. 109th Congress, 1st Session. S. 1912. 24 Oct. 2005
[8] William B., et al. “Wildlife Trade and Global Disease Emergence.” Emerging Infectious Diseases 11.7 (2005): 1000-1002.
[9] U.S. Agency for International Development. “USAID Announces $5 Million Award to Enhance International Efforts to Track Avian Influenza.” Press Release, 9 June 2006. 2 Oct. 2006. <http://www.usaid.gov/press/releases/2006/pr060609_1.html>.
[10] U.S. Centers for Disease Control and Prevention. “Spread of Avian Influenza Viruses among Birds.” 14 Oct. 2005. 6 June 2006. <http://www.bt.cdc.gov/scripts/emailprint/print.asp>.
[11] Karesh, William B., et al. “Wildlife Trade and Global Disease Emergence.” Emerging Infectious Diseases 11.7 (2005): 1000-1002.
[12] World Health Organization. “Ten Things You Need to Know About Pandemic Influenza, 14 October 2005.” 14 Oct. 2005. 9 September 2006. <http://www/who.int/crs/disease/influenza/pandemica10things/en/print.htm>.
[13] World Health Organization. “H5N1 Avian Influenza: Timeline.” 28 Oct. 2005. 8 May 2006. <http://www.who.int/csr/disease/avian_influenza/Timeline_28_10a.pdf>.
[14] Ibid.
[15] U.S. Centers for Disease Control and Prevention. “Questions and Answers about Avian Influenza (Bird Flu) and Avian Influenza A (H5N1) Virus. 19 May 2006. 6 June 2006. <http://www.bt.cdc.gov/scripts/emailprint/ print.asp>.
[16] World Health Organization. “Ten Things You Need to Know About Pandemic Influenza, 14 October 2005.” 14 Oct. 2005. 6 June 2006. <http://www/who.int/crs/disease/influenza/pandemica10things/en/print.htm>.
[17] xii Fields, Bernard, et al., eds. Field Virology, 4th Ed. Boston: Harvard University Press, 2001.
[18] xiiiU.S. Geological Survey. National Wildlife Health Center. “Field Manual: Avian Influenza.” 2 Feb. 2006. 13 Aug. 2006. <http://www.nwhc.usgs.gov/publications/field_manual/chapter_22.pdf>.
[19] xiiiU.S. Geological Survey. National Wildlife Health Center. “Field Manual: Avian Influenza.” 2 Feb. 2006. 13 Aug. 2006. <http://www.nwhc.usgs.gov/publications/field_manual/chapter_22.pdf>.
[20] xv Uyeki, T. “Public Health Impact of Avian Influenza.” Centers for Disease Control and Prevention. 3 Nov. 2004. 16 Aug. 2006. <http://www.cdc.gov/flu/pp/ph_impact_avian_fl_11_2004.pdf>.
[21] Li, W. D., et al. "Bats Are Natural Reservoirs of SARS-Like Coronaviruses." Science 310.5748 (2005): 676-79.
[22] xxi Food and Agricultural Organization. “Wild Birds and Avian Influenza.” 13 Aug. 2006. <http://www.fao.org/ag/againfo/subjects/en/health/diseases-cards/avian_HPAIrisk.html>.
[23] A Bill to Establish a Global Network for Avian Influenza Surveillance among Wild Birds Nationally and Internationally to Combat the Growing Threat of Bird Flu, and for Other Purposes. United States Senate. 109th Congress, 1st Session. S. 1912. 24 Oct. 2005.
[24] Ibid.
[25] World Health Organization. “Avian Influenza (“bird flu”) – Fact Sheet.” 2006. 16 Aug. 2006. <www.who.int/mediacentre/factsheets/avian_influenza/en/index.html>.

[26] Karesh, William B., et al. “The Human-Animal Link.” Foreign Affairs 84-4 (2005): 38.
[27] Convention on the Conservation of Migratory Species of Wild Animals. “Stop Ducking Hard Facts and Tough Policy Options on Bird Flu, Says New Scientific Task Force.” Press Release. 24 Oct. 2005. 15 Aug. 2006. <http://www.cms.int/news/PRESS/nwPR2005/pressrelease_AvianFlu_final_24_10_05.pdf>.
[28] Fergus, R. "Migratory Birds and Avian Flu." Science Letters 312.5776 (2006): 845-846.
[29] A Bill to Establish a Global Network for Avian Influenza Surveillance among Wild Birds Nationally and Internationally to Combat the Growing Threat of Bird Flu, and for Other Purposes. United States Senate. 109th Congress, 1st Session. S. 1912. 24 Oct. 2005.
[30] Mörner, T., et al. “Surveillance and Monitoring of Wildlife Diseases.” OIE Review of Science and Technology 21.1 (2002): 67-76.
[31] A Bill to Establish a Global Network for Avian Influenza Surveillance among Wild Birds Nationally and Internationally to Combat the Growing Threat of Bird Flu, and for Other Purposes. United States Senate. 109th Congress, 1st Session. S. 1912. 24 Oct. 2005.
[32] BirdLife International. “Important Bird Areas (IBAs).” 2 Oct. 2006. <http://www.birdlife.org/action/science/sites/index.html>.
[33] Library of Congress <http:/www.thomas.loc.gov>
[34] Department of Defense Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico, and Pandemic Influenza Act, 2006. U.S. House of Representatives. 109th Congress, 1st Session. H.R. 2863. 21 Dec. 2005.
[35] USAID. (2006). “USAID Announces $5 Million Award to Enhance International Efforts to Track Avian Influenza.” Retrieved 9 Sept 2006, from <http://www.usaid.gov/press/releases/2006/pr060609_1.html>
[36] Global Avian Influenza Network for Surveillance. http://www.gains.org
[37] Presentation: Bill Karesh. “Beyond Zoonoses: The Threat of Emerging Diseases to Human Security and Conservation and the Implications for Public Policy. www.oneworldonehealth.org/nov2004/presentations/kohkhenglian.html.
[38] Global Avian Influenza Network for Surveillance: collaborators and supporters. http://www.gains.org/collaboratorssupporters/tabid/102/Default.aspx
[39]Global Avian Influenza Network for Surveillance: collaborators and supporters. http://www.gains.org/collaboratorssupporters/tabid/102/Default.aspx
[40] Karesh, William B., et al. “The Human-Animal Link.” Foreign Affairs 84-4 (2005): 38.
[41] The Importance of Integrated Country Programs in the Fight Against Avian and Human Influenza. http://www.worldbank.org.
[42] China Accused of SARS Cover-Up. Http://news.bbc.co.uk/2/hi/health/2932319.stm
[43] China Accused of SARS Cover-Up. Http://news.bbc.co.uk/2/hi/health/2932319.stm
[44] China’s Disease Cauldron. Elizabeth M. Prescott. http://www.inthenationalinterest.com/Articles
[45] The Coming Pandemic? Todd Huffman. http://www.selvesandothers.org/article10371.html
[46] Karesh, William B., et.al. “The Human-Animal Link.” Foreign Affairs. 84-4 (2005): 38.
[47] Bird Flu Halts Dutch Exports.< http://news.bbc.co.uk/1/hi/business/2924847.stm>
[48] Avian Flu: The Economic Costs. <http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,content MDK:20979352~page PK:64257043~piPK:437376~theSitePK:4607,00.html.>
[49] Bird Flu Halts Dutch Exports. http://news.bbc.co.uk/2/hi/business/2924847.stm
[50] Bird Flu Halts Dutch Exports. http://news.bbc.co.uk/2/hi/business/2924847.stm
[51] Bird Flu Halts Dutch Exports. http://news.bbc.co.uk/2/hi/business/2924847.stm
[52] Bird Flu (Avian Influenza). http://www.mayoclinic.com/health/bird-flu/ds00566/DSECTION=3.
[53] Iowa Poultry Association. http://iowapoultry.com/about.htm
[54] U.S. Centers for Disease Control and Prevention. “Key Facts About Avian Influenza (Bird Flu) and the Avian Influenza A (H5N1) Virus”, 5 May 2006. http://www.bt.cdc.gov/scrips/emailprint/print/asp
[55] Bunn, David. Phone interview. 2 November 2006, Sandrock, Christian. Phone interview. 19 October 2006.
[56] United States Centers for Disease Control and Prevention. 2004. "Budget Guidance." Available <http://www.cdc.gov/od/pgo/funding/budgetguide.htm>. 3 Dec. 2006.