

e-Service Development of Avian Influenza (Bird Flu) surveillance System in Thailand

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Abstract

This development is an implementation of an integrated system, which performs distributed, collaborative and service oriented in several platforms for a prototype of e-government project, called e-service for Avian Influenza Surveillance system, which have the Avian Influenza information and knowledge. The developed system consists of 3 parts. The first part is an information provider, which provides up-to-date database. The second is Geo-informatics system (GIS). Inspectors can use Global Positioning System (GPS) to identify an incidents cases position and link to related map and related information. Finally, Service-Oriented Architecture (SOA), called data agent service registry, is used to integrate all related information and applied to solve data and service interoperability problems among organizations

Key Words: e-service, e-government, Service Oriented Architecture, Avian Influenza, Bird Flu, Surveillance System

1. Introduction

Since the beginning of July 2004, there have been reports of avian influenza (H5N1) or Bird Flu in poultry farms in Asian countries—Indonesia, Vietnam, China and Thailand. Following stringent efforts to eliminate avian influenza in poultry flocks early this year, Thailand is currently implementing post-outbreak surveillance to monitor infection status so that any recurrence of the disease is early detected and effectively contained. H5N1 avian influenza that happened in previous years had limited capacity to infect people and the man-to-man transmission has not been detected [1]. WHO and OIE have suggested that the recurrence of avian influenza in poultry in Asian countries is not unexpected [11]. Based on experience in several countries, once an avian influenza happens in a country or region, the virus will continue to exist in the environment for a certain period despite disease control in farms and domestic animals. Cullers, farmers and residents in areas where disease in chickens is found are advised on preventive measures. Ministry of Information and Communication Technology (MICT) together with Department of Disease Control (DDC), Ministry of Health initiate to develop an e-service system and will be a prototyping of the e-government project. The developed system integrated with web based application, Geographic Information System (GIS) and Web services.

2. Background

The avian influenza outbreak was witnessed in Thailand for the first time in January 2004. Thailand has recently had 3 epidemic rounds or waves of highly pathogenic avian influenza (HPAI) H5N1 outbreak with twenty-five human confirmed cases and seventeen death cases. First epidemic round was detected on January 2004 to May 2004, a total of 181 areas 41 provinces were confirmed with avian influenza in poultry, with 17 human confirmed cases and 12 deaths. Second round began from July 2004 to December 2004, a total of 206 areas in 39 provinces were affected, and there were 5 confirmed human cases and 2 deaths; virus was again detected in July 2005 (third round) [5], with a total of 167 areas in 27 provinces and there were 3 confirmed human cases with all died (www.who.int). The risk factors for human infection with influenza A subtype H5N1 were independently associated with H5N1 infection were preparing sick or dead poultry for consumption <7 days before illness onset, and having sick or dead poultry in the household <7 days before illness onset[3,13]. Factors not significantly associated with infection were raising healthy poultry, preparing healthy poultry for consumption, and exposure to persons with an acute respiratory illness [6,7,8].

Thai government allocated a budget of ≈5.3 billion Thai baht (US \$132.5 million) for direct compensation to affected farmers. As of March 2004, the HPAI epidemic had an estimated effect on the national gross domestic product of 0.39%. These losses amount to 25.24 billion Thai baht (US \$631 million). The reasons that indicates that why Thailand effected by Avian Influenza?, because before 2004 Thailand was among the world's major poultry exporters and produced ≈1 billion chickens per year; >400,000 persons were employed in the poultry industry. And Thai style, backyard poultry are raised for protein food in most villages including for fun such as raising fighting cocks and exotic birds [10].

Thailand, Ministry of Public Health and Related Ministries, activities on prevention and control avian influenza outbreak as following measures [12];

1) Disease surveillance and response during outbreak, to rapidly detect and control outbreaks of avian influenza in poultry and to closely follow up the changes in the situation, base on;

- Disease surveillance and control in animals, by implementation of proactive surveillance measure that would report back on disease outbreak within 12 hours, destroy the sick animals and their carcasses, disinfect the farms, restrict movement and consider appropriate use vaccines.

- Disease and Surveillance and control in human by preparation for continuous active surveillance system, stockpiling of antiviral and influenza vaccine, including set up the influenza pandemic preparedness plan.

- Set up ad hoc integrated mechanisms at all level, to function as the command centre during outbreak, in order to bring about rapid control of the disease.

2) Knowledge generation and management, which can use to efficiently solve problems of avian influenza, base on;

- Generate basic knowledge that is necessary for prevention and control of avian influenza in humans and animals.

- Research and development of vaccines which are ready for use during outbreaks, in humans and animals, including diagnostic kits which could lead to rapid screening examination and medicines treatment of avian influenza.

3) Capacity building of organizations and manpower, to strengthen capacity building of organization and manpower working on surveillance and control at all level, base on;

- Develop the capacity of disease surveillance and control in humans, with the established of efficient epidemiology units in every district, experts in other field.

- Develop diagnostic capacity in humans, by set up a system of network of laboratories at the central, provincial and hospital levels to support prompt and accurate diagnosis of influenza in humans.

- Control of avian influenza in the hospital, by development of medical personnel in areas of infectious diseases and establish isolation rooms for patients infected or suspected of being infected with serious communicable diseases.

4) Create understanding and participation of the civil society and private sectors, to strengthen the roles of civil society and private sectors, in prevention and control of diseases outbreaks, base on;

- Promotion of self grouping, for coordination between small scale farmers and those in the concerned occupation.

- Develop of village health volunteers to monitor and control disease outbreak in the community, and develop effective public communication at all levels.

5) Develop sustainable integrated management systems and mechanism, to crate efficient and united mechanisms for the management of avian influenza problems, base on;

- Develop mechanism to manage problems of avian influenza under normal circumstances, by establishment of knowledge management

mechanisms, whereby full time staffs are employed under a permanent setting.

- Develop mechanisms to manage problems of avian influenza during outbreaks, by establishment of a national level committee and a national level operations center and develop management systems at local levels.

However for avian influenza, all epidemiological data collection (surveillance) and information publication on HPAI outbreaks in Thailand is responsibility by different department and ministry, such as the Department of Diseases Control, Ministry of Public Health (for human), Department of Livestock developments (DLD.), Ministry of Agriculture and Cooperatives (for poultry), and Ministry of Resources and Environment (for wild birds). Early warning, early detection, and early response are essential to prevent and control HPAI of all cases was essential to rapidly implementation. Meanwhile, comprehensive veterinary surveillance and long-term control measures are required. The success of HPAI elimination, therefore, depends on a collaboration of all stakeholders, including farmers, industries, veterinarians, public health authorities, academic institutions, media, and the government (Public Health, 2005), while in the past, Thailand lack sharing information from related departments. The developed e-service system will solve this problem using management information system together with Geo-Informatics system (GIS) and web service systems.

3. Methodology

The developed e-service system consists of three sub-systems as followings:

- The development of Geo-informatics system (GIS) which cover the whole area in Thailand.
- The development of a Management Information System (MIS) to collect information which related of Avian Flu.
- The development of Information exchange, which is applying Service Oriented Architecture (SOA) in each related organizations so that the information system can be maintained locally and exchange to other organizations, which can reduce the maintenances cost and benefit from the information.

Figure 1 shows the conceptual model. There are three servers including: application, database and map servers. The application and database servers used for Avian Influenza surveillance management information system. This system sent locations for incident cases to GIS (located

in Map Point Asia system) using XML. The GIS return map and area based information to users who have responsibility to control this disease.

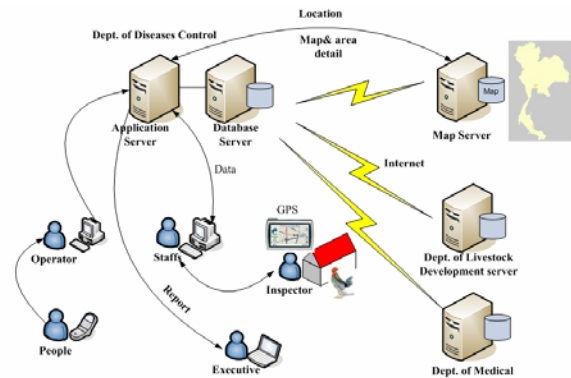


Figure 1. Conceptual Model of e-Service System

3.1 Geo-Informatics Sub-System (GIS)

Currently, there are research studies that demonstrate the usage of integrated technologies for epidemiology studies that made new discoveries around the world. In addition, Geo-informatics technology is utilized in the epidemiology, epidemics, and research studies in various cases. For example, remote sensing and GIS was utilized as tools for area based analysis together with survey methods [4,9]. There are various cases around the world that remote sensing and GIS was used to assist epidemiologists to pin point and help to identify source of disease.

By utilizing geo-informatics technologies, this project co-operate with Map point Asia system [14], which used ICONOS satellite images.



Figure 2. The link to Geo-Information System (GIS) of Map point Asia system [14]

3.2 Management Information System (MIS)

There are three subsystems including: Surveillance, Knowledge Management and Reporting. The users in this system can be divided in three groups. The first is village health volunteers. The second is hospital and health care staffs and the last are regional or center officers in Department of Disease Control, Ministry of Health. Each of user's group is different level of updating and viewing information. The volunteer is the lowest priority. They can inform incident cases to this system. The system will forward this information to DDC staffs to inspect particular case and update status to the system using EP7 form. If there are some patients admit to hospitals. The health care officers will identify and inform the system using AI2 form, which will automatically inform to DDC and related staffs. In case of animal cases, Department of Livestock development staffs will allow to use the system but can't modify anything. The designing of the system was shown in Figure 3.



Figure 3. Use Case Model of e-Service System

Figure 4 shows an user interface design which provides user-friendly design of the administrative and manageable data.

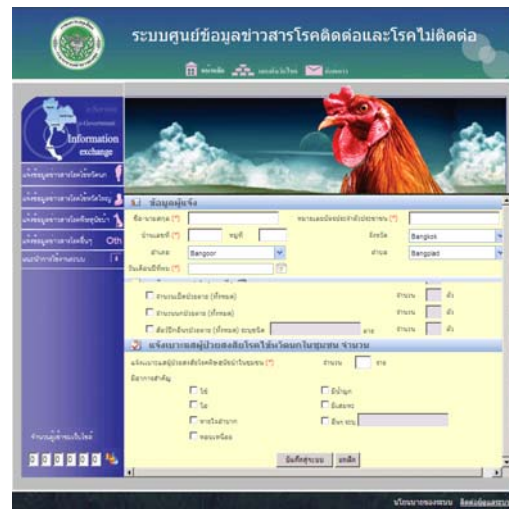


Figure 4. User Interface of e-Service System

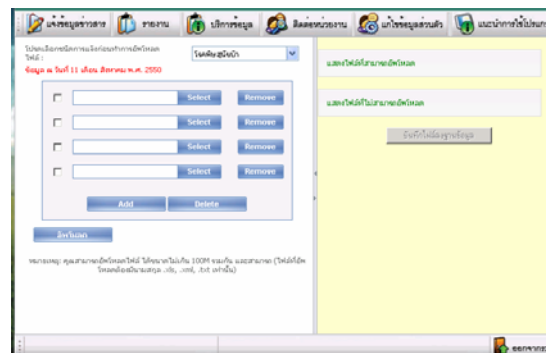


Figure 5. Data upload from related organizations to the system in case of bulk data transfer.

3.4 Information Exchange using Service Oriented Architecture (SOA)

Recently, the managing and exchanging information among related organizations has limitations of different standard format, for instance the differences of data schema specification, operating systems and database system or engine. These are resulted in difficulty and mistaking of exchanging the cultural record information shared among related organizations.

Service oriented architecture (SOA) is a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains [2]. It provides a uniform means to offer, discover, interact with and use capabilities to the producer and desired effects consistency with measurable preconditions and expectations. SOA can create benefits for information management in HPAI.

For the developing this system, there will be building and exchanging the Avian influenza metadata of each related organization as shown in Figures 6 and 7. In order to share information on the system, data

Agent will be in charge of managing and exchanging information under the standard agreement of metadata.

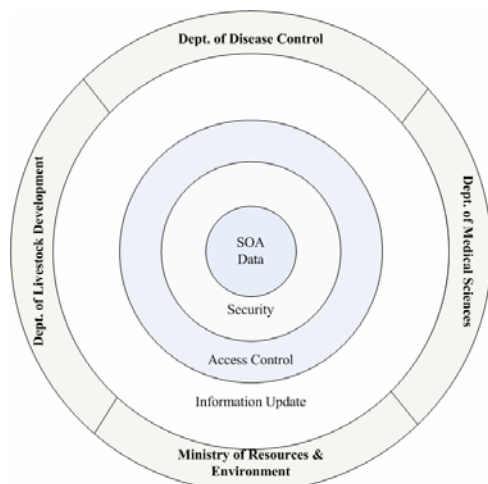


Figure 6. Shows related organizations update their information, which already defined the same data models, security policies and access control in the e-service using service oriented architecture.

Web services interfaces are enabling multi-channel access including Web, Java, .net, mobile devices and so on. It provides methods to request services from other e-service providers and sending data in XML format.

In Figure 7, service-oriented integration is applied for integration of web services because it can solve the interoperability problem among several Avian influenza related information providers which have different architectures, platforms and data models. The existing data models were refined to accommodate this information integration. Formal service contacts were defined beyond web-service definition language (WSDL) definition to include rules, security and management policies. Data transformation was used to map data between different data models when the data cross service domain boundaries.

Please note that: DDC is Department of disease control, DLD is Department of livestock development, and DMSC is Department of medical sciences.

In the future, users from multi-channels can access to e-service system, which link to Data Agent Service registry for information integration.

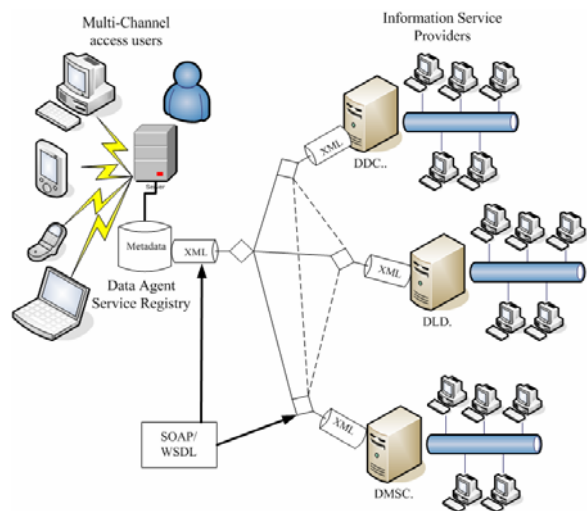


Figure 7. Shows Service-oriented integration with store data service and process models for the service domain in each country in a metadata repository.



Figure 8. Report system for related organizations

4. Prototype and Implementation

Nowadays, The Ministry of Public Health has set up the important policy to increase the efficiency of Health Services, Health Consultant Services, and Epidemics Watch by using information system. This also supports the change of organization continuously by developing the knowledge base of services in order to utilize the organization's human resources as efficiently as possible. Recently, the trend of Communicable Diseases concerned, Ministry of Public Health are; for example, AIDS, STDs, Dengue fever, Cholera, Anthrax, SARS, Avian Influenza and so on.

In early 2004, lacking of information and communication with regard to HPAI caused the public to lose confidence in poultry products. The decrease in domestic consumption and bans on Thai poultry products by importing countries damaged the poultry industry. On Avian Influenza, e-Service Development roles on supporting prevention and

control measures in human are maintained strict adherence to disease surveillance and clinical management of patients with influenza or pneumonia. Prompt early detection which leads to disease investigation and disease control in infected areas including appropriate case management, finally, will reduce case fatality rate. The details of e-Service Development roles are as follow;

1. Public awareness or educate the public on avian influenza transmitted prevention and to encourage relevant parties to be aware of HPAI and to disinfect their facilities, e.g., poultry houses, farm equipment and vehicles, slaughterhouses, and retail markets. Soaps, detergents, alkalis, acids, aldehydes, chlorine, and quaternary ammonium compounds were used as disinfectants. And to bolster consumers' confidence that poultry and their product was safe and reports local authorities when found dead or sick poultry in villages. In addition, e-Service acts as focal point for connecting to related departments and ministries for information such as asking compensation after their poultry culling.

2. All Health care workers epidemiological information for all levels, including Stockpiling of antiviral and influenza vaccine data include personal protective equipments for prevention and control outbreak;

- Village Health Volunteers (VHVs), on monitoring for infected or dead birds and anyone having flu-like symptoms in villages (fever higher than 38 degree or chill, myalgia, especially, those who have such symptoms more than 2 days). If any, the patients should seek medical advice at the health centre. Any individual presenting with high fever and having been in an area where infected or dead birds occurred within the past 1 month, he/she must be referred to a community hospital via the existing referral system and a report must be sent to the District Health Office immediately.

- Hospitals and health care facilities, Provincial Health Offices and Bangkok Metropolis Administration, either government or private sectors, on monitoring for suspected/probably/confirmed Avian Influenza cases presented or referred case or observed any individuals with pneumonia and influenza, including fever of unknown origins via e-Service. For example, practices on treatment and handle patients who obtain an exposure history of each case regarding housing in contaminated areas with infected or dead birds within the period of 14 days prior to the onset of illness or having a history of direct or indirect contact with faeces or secretions from infected or dead birds within 7 days prior to illness or being in close contact with other patients having lung inflammation within 10 days prior to the onset of symptoms. He/she must be carefully

examined by a chest x-ray, specimens collected by nasopharyngeal swab and confirmed at the Department of Medical Sciences (DMSC.), and a screening test for influenza virus type A using Rapid Test. Also be treated with antiviral immediately if the result is positive or even a negative result but with some matching symptom, isolated and placed in a single room according to the standard precautions of the Ministry of Public Health [12].

- Regional and center offices; on detecting possible HPAI infections in poultry (sick and dead) and human for suspected/probably/confirmed Avian Influenza cases presented via e-Service. Early warning and consultant, also, health care workers and related office via e-Service or SMS for early investigation, and response outbreak at the first area where found cases.

3. Related agencies and institutions; on monitoring for changes in disease situation. Update information and sharing information should available at all related departments by web application or e-Service or via telephone by contact call center.

5. Conclusions

The developed e-service system for Avian Influenza (Bird Flu) surveillance in Thailand is one of the pilot projects of e-Government. This system can work with both Intranet and Internet. For the Intranet case, the software supports management information system and Geo-informatics technology which assists the staffs of Avian Influenza related organizations. It reduces the redundant work and enhances the efficient administrative work that is directly useful for diseases control. It is also dissemination of knowledge and information to the public through the Internet. Moreover, it makes the people have contribution to report Avian Flu incidents. Besides, the users can access information, which describes information, map, and etc. Therefore, this system is the good knowledge resource for surveillance and research as well. The e-service system can handle working level for both administrative part in the Intranet and accessible information part in the Internet with the authentication system and security system. A principle of design is a user-friendly design of the administrative and manageable data. The data are stored in multiple database systems and interoperability using service oriented architecture. The users can access information such as staffs, inspectors and executives through World Wide Web via the Internet. Up-to-date data is modified by the data owners who are working from related organizations. In future, the portal system will be develop to extended this system without limitation

and it will be connected from multiple devices such as personal computers, laptops and mobile devices which will enable healthy society in Thailand.

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