

**Applicant type:**

FETP Trainee

**Title of Project:**

Timeliness of Detection and Notification of Infectious Disease Outbreaks in Taiwan: 2003–2013

**Problem Identification and Definition:**

Because of rapid change and convenience of modern international air travel, possibilities for infectious diseases to spread from one side of the world to another in months or days raises [1-3]. The international spread of infectious diseases makes surveillance and implementation of control measure more difficult and complicated. The best examples are the outbreak of severe acute respiratory syndrome (SARS) in 2003, avian influenza A (H5N1) in 2005, and the pandemic influenza A (H1N1) in 2009 [2,3].

In response to the threat of international infectious disease outbreak such as SARS and pandemic influenza A (H1N1), public health professionals who work on surveillance partly turn their focus from traditional indicator-based surveillance systems to event-based systems which are used to improve and support traditional surveillance systems and is considered to have the advantages of lower cost, more rapid detection, and feasibility to implement in resource-limited settings [4-7].

Taiwan is a small island with a 36,193 km<sup>2</sup> area and twenty-three thousands population. It 180 kilometres off the southeastern coast of mainland China and located in a key position for other surrounding countries. Because of proximity to neighboring countries such as Philippines, Malasia, Japan and China and substantial amount of international trade and travel, disease outbreaks in Taiwan are often represented by imported diseases of regional significance, such as measles, rubella, and dengue fever; or of global significance, such as the epidemic of SARS in 2003 and pandemic of influenza A (H7N9) in 2013.

Taiwan Centers of Disease Control (CDC) has endeavored to improve the surveillance systems of infectious diseases. In Taiwan, outbreaks are mainly detected through pre-defined alerts of the Notifiable Disease Surveillance System (NDSS) and syndromic surveillance systems, or from an event-based system which receives active reports from physicians, facilities, laboratories, the public, and the media. The systems are similar to the epidemic intelligence system established in Europe in response to the revision of the International Health Regulations (IHR) (2005) and is considered to have more completeness and strength [8]

Although event-based systems are perceived to be useful and reliable [5-7,10], the timeliness and accuracy of the systems have not been fully examined<sup>9</sup>. In the pioneer study of Chan et al. published in 2010 [11], the researchers evaluated the elapsed time from the outbreak start to its discovery and the awareness of the public and public health professionals. They found decreased median time from the outbreak start to detection and reduced elapsed time of public communication with geographical variation. Therefore, it is of public health interest to perform similar assessment and characterize the improvement of timeliness locally or regionally.

**Justification of the Project:** Importance of surveillance and evaluation in public health

Evaluation of a surveillance system is necessary to ensure that problems of public health importance could be mostly efficiently detected and management. It is also important to ensure that the data of the surveillance system is collected by the most efficient and reliable way.

Taiwan CDC is committed to protecting the health of the public and prompt identification, intervention and control of infectious disease outbreaks is one of the most important duties of the institution. Surveillance systems to detect outbreaks have long been in place in Taiwan. However, after the implementation of current surveillance systems established by Taiwan CDC, no study has focused on the timeliness of those systems by assembling and comparing across the difference surveillance systems. Therefore, this evaluation project, led by Taiwan Field Epidemiology Training Program (FETP), will demonstrate strengths and weakness of the systems with regard to timeliness and usefulness, and provide guidance for my staff to improve the systems.

By implementing this project, this study will help Taiwan CDC to develop a new method to evaluate the timeliness and efficiency of current surveillance system and event-based outbreak investigation system and established the baseline measurements both in regional and national level. As a result, the public health professionals in Taiwan CDC can further identify the gap between the standard protocol of outbreak investigation and the response of local public health workers and the common public. It can also provide the opportunities to follow the improvement over time and the influence made by major public health events such an outbreak of an emerging disease such as SARS, pandemic influenza A (H1N1) or the implementation of IHR (2005) since 2009.

Furthermore, by identifying the elapsed time between the outbreak start, discovery and the public communication, this study may provide the public health professional more information about the strategy of public communication.

#### Field Epidemiology Training Program and medical officers

Taiwan FETP was established in 1984 to train public health professionals as disease investigators. The program is a 2-year on-the-job training which emphasizes hands-on field investigations and analysis of public health surveillance data. After the emergence of SARS, Taiwan CDC began to recruit medical officers in preparation for emerging infectious diseases in 2005. FETP has become a mandatory training program for newly recruited medical officers.

Being a trainee of FETP, the medical officers have the ability to communicate with local media sources and exam the report in Chinese and thus they can this can more deeply analyze the information and context of the whole course of outbreak. By using the database provided by Taiwan CDC, they can collect all the data of each outbreak occurred in local, regional and national level and provide more thorough data for further evaluation.

As a part of the FETP, FETP trainees will be more familiar with the event-based surveillance tools both from formal and informal source such as ProMED-mail, HealthMap, and GPHIN and thus they could estimate the timeline of an outbreak from different respective.

Goals & Objectives. State goals in terms of potential impact or public health purpose of the study/program. State goals in terms of potential impact or public health purpose of the study/program:

The aim of this project is to evaluate the current surveillance system, to identify if Taiwan's efforts in disease surveillance have led to faster detection and notification of infectious disease outbreaks, and to provide solid evidence to call for improvement of the outbreak surveillance system in Taiwan

#### **Study objectives**

- Describe the attributes and elapsed time from outbreak start to other key dates.
- Evaluate the timeliness of outbreak start and detection.
- Evaluate the timeliness of outbreak start and reporting.
- Identify the temporal and geographical difference of the timeliness of current surveillance systems.

#### **Methods:**

**Data date range**

The data from January 1, 2003 to December 31, 2013 will be collected.

**Data Sources**

## 1. Official reports

Epidemic Investigation Report Files Management System.

Epidemic Investigation Report Files Management System is an event-based and internet-based system used by public health professionals to record and track the progress of infectious disease outbreak and cluster investigation.

Once notified of a suspected outbreak, local public health professionals are required to register the outbreak into this system and investigate the outbreak with supervision provided from the Taiwan CDC's regional control centers. Patient or parent interviews, questionnaire surveys, and environmental inspection are commonly conducted to identify source and extent of the outbreak.

After the preliminary investigation, the local public health professionals will upload a preliminary investigation report for the possible outbreak which includes the date of disease onset of the index case and other cases, the context and the population involved in the outbreak and the plan of public health response and implementation of control measures or interventions. Laboratory testing on human and environmental specimens are conducted at Taiwan CDC's Research and Diagnostic Center to identify etiologic agents.

After the outbreak subsides, a final report will be produced to describe the whole picture of the outbreak, including the epidemic curve, the confirmed laboratory results of pathogen, the outcome of all involved cases and the records of public response.

In 2013, of 497 suspected outbreaks which were registered into Taiwan CDC's Epidemic Investigation Report Files Management System and investigated by public health professionals at local health departments, 297 (60%) were confirmed as outbreaks. The top four reported diseases/syndromes of confirmed outbreaks were varicella/chickenpox (34.7%), acute diarrhea (21.5%), acute respiratory infection (21.5%), and influenza-like illness (5.4%)

National Notifiable Disease Surveillance System.

The Notifiable Diseases Surveillance System (NDSS) is a web-based portal onto which medical personnel must report any suspected cases of a notifiable disease (Appendix One). A standard minimum dataset is collected.

The surveillance system is passive but enhanced surveillance with active case-finding is initiated when the cluster of similar cases in time or geographical area and a possible outbreak is suspected.

After being reported to the notifiable disease surveillance system, all entered cases are categorized into possible, probable and confirmed cases according to the clinical and laboratory findings. All cases will be followed up by public health personnel who will administer a standard notifiable disease questionnaire and will use this to update the NDSS. Laboratory results are also added to these notes on the system when they become available by local or central health staff that can access laboratory results based on the patients' ID numbers, which are all unique.

The final report of NDSS includes the date of disease onset, the date of report to the NDSS, the date of the sample collection and the results of the laboratory examination. Most diseases are laboratory confirmed either by serology tests or PCR tests.

## 2. Informal reports

### Event Information Site of WHO.

The Event Information Site is a secure website developed by WHO to facilitate communications with the National IHR Focal Points as part of the implementation of the International Health Regulations (2005). Any events with possible international public health risk is required to be reported to WHO via the IHR Focal Points and the reports will be disseminated via this site to other member states need to know to respond.

### ProMED-Mail.

The Program for Monitoring Emerging Diseases is international web-based reporting system which was designed to collect information about the outbreaks of infectious disease and acute toxin exposures. The source of information includes local and international media, regional observers and official reports. The information will be summarized and disseminated via the ProMED website and e-mail subscribers.

### GPHIN.

The Global Public Health Intelligence Network (GPHIN) is an early warning system based on the internet. Through its automated system, it gathers and categorizes the information about disease outbreak and any event with public health significance in nine languages including traditional Chinese. The experts will review these information periodically and categorized them by relevance and importance and then send alerts to subscribers.

### HealthMap.

HealthMap, established in 2006, is an internet-based automated system that collects both formal and informal reports of disease outbreak on the internet. The system could automatically collect information in nine languages including Chinese, categorizing by geographical location and the time series, then visualizing them on an interactive map on the website.

### Press releases of Taiwan CDC.

In order to efficiently communicate with the public about the information of disease outbreak, either local or international, Taiwan CDC released official press to the public and social media to communicate with the current situation of an outbreak if necessary. The website of Taiwan CDC contains all the press release after June 2001.

### Newspapers in Taiwan.

The National Central Library in Taiwan maintains the database Newspapers in Taiwan, which includes news title index of at least 13 domestic newspapers. This data-base contains near 14 million of news coverage and the user could search the information online via its web-base user interface.

### Outbreak milestones

We establish the time point for each outbreak, including the date of outbreak start, the date of outbreak discovery, the date of first public communication, the date of public health response and implementation of control measures. The date of report or communication to international community might be acquired after Taiwan joined the network of IHR in 2009 but it may not be readily available before. However, the report may be found in the non-official reporting system such as ProMED-Mail.

We tried to estimate and identify the earliest date of the "outbreak milestones" according to the following definitions:

Milestone	Description
Date of Outbreak Start	Date of symptom onset in index case OR data of hospitalization or medical visit for index case
Date of Outbreak Threshold	Date that cluster of cases reached threshold to be considered an “outbreak” (threshold may vary by disease type).
Date of Outbreak Report	Date of official outbreak report to public health authorities (via provider, hospital, lab, etc)
Date of Laboratory Confirmation	Date of confirmatory laboratory report for index case or other epidemiologically-linked case
Date of Initial Public Health Response	Earliest date when public health authorities took action to mitigate outbreak in the community (e.g. boil water advisory, vaccination, social distancing, etc.).
Date of Public Communication	Date of the first release of information about the outbreak that appeared in local or international, formal or informal, verbal or written reports – including press releases, news articles, TV or radio broadcasts, internet postings, social media, or informal disease reporting networks such as ProMED, HealthMap, or GPHIN.

### Data Assembly

A full list of all officially reported infectious disease outbreaks will be obtained from the event-based system, Epidemic Investigation Report Files Management System, from January 1, 2003, to December 31, 2013. The system is maintained by Taiwan CDC and the final outbreak reports were all confirmed by the supervisors in regional control center of the headquarter of Taiwan CDC.

The outbreak reports who meet the following criteria will be excluded:

- Isolated or single cases of disease
- Cases of disease occurring only in animals
- Food-borne outbreaks (In Taiwan, instead of CDC, it is FDA that is responsible for the investigation and control measures of food-borne outbreak)
- Non-natural cases (e.g., acts of bioterrorism and laboratory accidents),
- Non-infectious health events

For the enrolled outbreak reports, other key dates such as the date of public communication and the date of implementation of control measures are identified for each outbreak by comparing the data from both formal and informal reports, including ProMED, GPHIN, the official press releases of Taiwan CDC or data base other social media.

### Analysis Plan - Preparation of the data

A case-report form is designed to transfer to narrative case report of the outbreak into a structured form and then inputted in computer program. Data will be extracted from the Epidemic Investigation Report Files Management System by the principle investigator and other collaborators FETP trainees of Taiwan CDC and maintained using Microsoft Excel. The database would include variables as below:

- The ID number of each outbreak composed by the year of outbreak start and the serial number we code in the data

assembly. It will look like “year”+”serial number”.

- The regional control center in charge of the outbreak investigation
- Type of outbreaks such as respiratory diseases, gastrointestinal disease, unknown focus of fe-ver, unknown disease outbreak,
- Date of outbreak start, date of outbreak discovery/report and other key dates we describe above.
- The final result of laboratory confirmation

After the establishment of the database, firstly we would exclude the outbreak without available dates of outbreak start and outbreak discovery and then search the date beyond the study period to find type error.

We will clean the data by excluding the outbreak with incompatible chronological key dates. For example, the estimated date of outbreak discovery should not be earlier than the estimated date of outbreak start, or estimated date of public communication should not be earlier than the estimated date of outbreak start.

### **Analysis of the data**

The time from the start of the outbreak to the other outbreak milestones such as the date of outbreak discovery will be calculated for each outbreak.

For descriptive analysis, the average and median time including 95% confidence intervals will be presented both annually and for the entire study period. Appropriate chart such as bar chart will be produced to visually present the change of difference over times. The difference of these time variables will be calculated and compared for each year during our study period and for the periods before and after some major events, such as the H1N1 pandemic outbreak. These data will also be analyzed according to the geographic area of the area center of Taiwan CDC.

Univariate Cox proportional hazards regression analysis was performed using the key dates such as outbreak discovery and public communication as outcomes.

Plans for Interpreting the Data. Explain the following: what are the limitations of this study and what are the potential contributions of the study:

This study is based on the national surveillance system as the results of timeliness evaluation could reflect the improvement of the national-wide outbreak investigation system and the elapsed time from outbreak discovery to public communication will be a guide in the future when the director and other public health professionals face the treat of next major outbreak. The geographical difference may be due to the different adoption of the protocol of the Taiwan CDC or the different epidemiology of individual infectious diseases and will be useful in the discussion of internal meeting of all the stakeholders of regional control centers and headquarter.

Because Taiwan is politically and economically stable country in southeast Asia and has higher transparency of the information of disease outbreak, the results of this kind of evaluation study may be more reliable and can provide a good reference for surrounding countries who are maintaining the infectious diseases surveillance systems since the pattern of diseases and the epidemiology are similar within this area.

However, because Taiwan has not been recognized as an independent policy entity of the world, the information about outbreak report appeared in the official system such as WHO Disease Outbreak News did not include Taiwan as a separated category. As a result, it is difficult to compare the data from those internationally official report systems although some informal reports can be found in the non-official websites such as Pro-MED Mail.

Plans to report study findings. Explain what reports are planned, how do you plan to disseminate your results, and how will you communicate results to your partners:

The progress report will be produced when the assembly of database and the cleaning and editing of data are finished. Descriptive analysis will be performed and the preliminary results with tables will be made. The progress report will be presented and discussed in the monthly meeting of the medical officers and FETPs trainees in Taiwan CDC. Any suggestion about the further analysis of this study will be implemented in the subsequent analysis such as the Cox proportional hazard regression analysis.

The preliminary report will be written by a FETP trainee as the principle investigator of this study in November 2014. The principle investigator who writes the preliminary report will attend the TEPHINET Global Meeting in spring 2015, communicate, discuss about the major findings and share the field experience in Taiwan with other member of FETP from other countries.

After the final report including the further analysis, the final report will be presented in the monthly meeting of all medical officers and FETP trainees in Taiwan CDC again and any recommendation about the improvement of the current surveillance systems invoked by the major findings of this study will be shared with appropriate stakeholders in Taiwan CDC and its regional control centers in the weekly internal review meeting.

After all, the major findings of this study and the experience of conducting such quantitative study of the evaluation of an event-base system will be written as an original research article and submitted to a peer-reviewed journal.