

## Constructing an Amoebic e-Questionnaires System

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## Abstract

*In order to establish a comprehensive and flexible epidemiologic and laboratory investigation system, the Taiwan CDC initiated efforts in constructing an Amoebic e-Questionnaires System to prepare for the future needs of bioterrorism and emerging/reemerging infectious diseases. The concept of Amoebic e-Questionnaires System was to establish a uniformed comprehensive infectious disease investigation system with advantages of timely data collection, can accommodate the future needs including generating situation-suitable questionnaire within seconds, and filling up experience gap, and can chronologically analyze the same disease, syndrome, and scenarios or individuals over time. This system can accommodate twenty basic modules that may be grouped into a flexible module question bank to cover the investigational needs of 44 notifiable diseases, 23 reporting infectious diseases, six acute and severe syndromes from the syndromic surveillance systems and other uncountable scenarios covered by the Investigation Taskforce for Diseases of Unknown Causes. This system is anticipated to serve as a crucial part of the preparedness for bioterrorism and emerging/reemerging infectious diseases.*

*Keywords: emerging infectious disease, web-reporting, field investigation, syndrome, surveillance, Taiwan*

## Introduction

The epidemics of severe acute respiratory syndrome (SARS) caused by new coronavirus (SARS-CoV) attacked China, Vietnam, Hong Kong, Singapore,

Canada and Taiwan in 2003 leading to tremendous economic loss, physical and mental damage and breaking down of public health system there. (1;2). Since the symptoms and signs of SARS were nonspecific and there were difficulties of testing for SARS (3). The national and international responses under the ethical issues should be privacy, liberty and public's health (4). The best way to prevent transmission of SARS-CoV efficiently is to block any possible contacts after the suspected patient with the onset of fever was identified. Thus, the contact tracing and epidemiological linkage analysis are the most important elements in early prevention and control.

Before the first hospital outbreak of SARS occurred on April 23, Taiwan government interrupted the transmission of imported SARS cases successfully. After the event, similar to the outbreak of SARS among hospital workers in a community hospital in Hong Kong, numerous reporting, inquiring and epidemiological investigations occupied the Notifiable Diseases Reporting System, telephone and fax and making the important clinical and epidemiological data almost impossible to be collected timely (5; 6). In addition, shortage of data process personnel to key in the paper-based questionnaire and medical professionals to review made the epidemiological linkage between case-patients and contacts difficult to obtained in a timely manner.

The conveyance of the SARS cases, visitors and passengers also poses a problem of contact tracing and monitoring. Since time constrain of public health professionals at the local health departments in conducting epidemiological investigations in details for all case-patients and contacts, the need of rapid analyzing data for those case-patients and contacts at both macro- and micro-level existed, particularly during the time periods of outbreaks. After the ending of 2003's global SARS epidemics, hundreds of public health personnel quit the job, creating experience gaps and more difficulties in training new blood. All these above

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challenges pose an urgent need for initiating a uniformed and standardized investigation system with more flexibility, like an Amoebic. Therefore, the Taiwan CDC started efforts in establishing a simple, easy and flexible "Automation Informatics System" for Data Collection and Processing on constructing a Web-based Amoebic e-Questionnaires System (AeQS) to prepare for the future need of bioterrorism, emerging and reemerging infectious diseases.

## Material and Methods

### Conceptualized Model for Amoebic e-Questionnaire System

A web-based questionnaire system was developed and tested for SARS in May, 2003 and would be reconstructed and extended to diseases involving 44 notifiable diseases, 23 reportable infectious diseases, six categories of acute and severe syndromes from the syndromic surveillance systems and a uncountable scenarios covered by the Investigation Taskforce for Diseases of Unknown Causes (ITFDUC). Once the resources were mobilized, information of each reporting cases would be compiled very quickly to generate a data pool containing all the uniformed fields and modules for finding out possible clustering cases or potential epidemics (Figure 1).

We scheduled to construct 20 basic modules including demographic module, clinic information module, risk factor module, risk contact matrix module, living habits module, occupation and school module, nutrition and diet module, environmental exposure module, disease history module, immunization module, behavior of seeking medical assistance module, contact history module, clinical sequelae module, congenital factors module, cognition and education module, preventive measures module, sample collection module, laboratory module, final report and analysis module, note and warning notification module. Within each module, we collected and uniformed all the questions

used to collect the information in the notifiable diseases investigation and created a module question bank. There would be different ways of inquiring a question for different route of transmission or preventive needs and we collected and unified all those ways of inquiring as complete as possible. We preset those module questions that would select out as different sources of reporting system and generate uniformed questionnaires for different usage and marked questions we need in the module question bank for those diseases with unknown cause to generate flexible questionnaire (Table 1). The flexibility to add, delete or modify questions and modules in the module question bank was set up in advance for convenient changes whatever needs comes up. Through this AeQS, a new questionnaire for those unpredictable scenarios would be easily generated under the same module question bank in an amoebic way.

### Format of Questionnaires, Data Entry and Transmission

The formats of the questionnaires will be generate though a transforming program to transform from the module question bank into a web-based questionnaire, in which the data entry would be very similar to what it looks like in a paper-based questionnaire. Those investigators, public health nurses and epidemiologists could be easily entered the questionnaire by telephone interview, face-to-face interview at the same time, or self-administered questionnaire or traditional interviewed using a paper print out and then reference back to data entry.

The entire previously established investigation database for each individual notifiable disease will be transformed into this Amoebic e-Questionnaires System at the time before it is released. The advantage of this Amoebic e-Questionnaire System is that all the module questions marked for these reported diseases or syndromes will be compiled together for avoiding redundancies and increase efficiency if a patient were reported from more than two different sources.

The Amoebic e-Questionnaires System (AeQS) were referenced to the Notifiable Disease Reporting System, Syndrome Surveillance System and ITFDUC in Taiwan CDC. Any reporting into these systems will generate a notice email to the public health nurse and their supervisor. The investigator could enter the questionnaire through a united entry and finish the data entry for all the diseases and syndromes reported. The AeQS will reference to our Residents and Residency Registration Information System (RIS) under an automatically generated certificate to ensure the safety transmission and hourly check both those reported cases in the RIS to download the formal registered information of the case-patient to reduce the typing error, information error and work load. In addition, the AeQS will reference to the National Immunization Information System (NIIS) to obtain all the immunization records of the reported cases and contacts.

All the data fields meets health level seven protocols (HL-7) and were packaged into eXtensible Markup Language (XML) file and transmit to our central Amoebic e-Questionnaires System data pool automatically.

#### **Data Processing, Cleansing and Standardization**

The Amoebic e-Questionnaires System will check any missing required fields and pump out notice information at the moment of saving and transmission. The system will also check the logics and check code and notify any mismatches till the error were confirmed or cleaned.

All the fields except laboratory module, report and analysis module, and note and warning notification module were in a standardized form.

#### **Data Analysis and Report**

The system will generate a routine final report including epicurve; frequency tables of demographic information, risk factors and symptoms and signs, and relative risk of each risk factor, right after each scenario

or event were entered.

In addition, the investigators, public health nurses, and epidemiologist could download the selected database for further analysis based on their authorized level.

#### **Results**

The Amoebic e-Questionnaires System is still under construction. Up to now, we had established module questions bank including 256 questions used in respiratory transmission, fecal-oral transmission, sexual and contact transmission, vector-born transmission, zoonosis infectious diseases, and all the notifiable diseases into twenty modules and also important scenarios including unknown diseases in school, military, household, nursing home, company clustering or outbreak for different syndromes for Amoebic e-Questionnaires System.

In addition, we are currently working on the reference checking between different systems including Notifiable Diseases Reporting System, Syndrome Surveillance Reporting System, National Immunization Information System, Residents and Residency Registration Information System and other established individual diseases investigation systems.

#### **Discussions**

The concept of Amoebic e-Questionnaires System was the first to generate a comprehensive infectious disease investigation system. Tanaka et al. mentioned a universal questionnaire needed for investigation of enterohemorrhagic *Escherichia Coli* (7). Here we proposed an even advance electronic system containing unity, simplicity and flexibility.

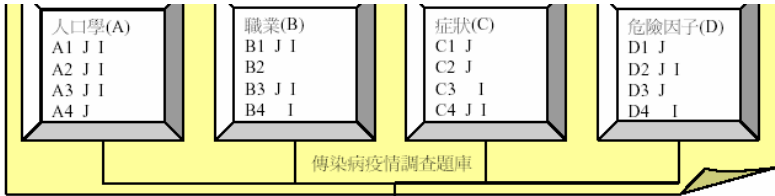
The advantages of this system are to organize all the investigation information into a uniformed standardized data pool, to reserve the flexibility of generating buffet questionnaire, to shorten the experience gaps, to and to review the diseases through comprehensive dimensions.

It would be very easy to communicate between international-level, government-level and hospital-level by using the AeQS. The modularized questions were also provides the feasibility for future needs including generating situation-suitable questionnaire within seconds, adding new modules and questions and arranging question formats. These advantages are especially important under the era of tremendous bioterrorism, emerging and reemerging infectious disease threat. The Amoebic e-Questionnaires System will fill the experience gap of the fast run off or rotation of the investigators, public health nurses, and epidemiologists. Even a just graduated would easily handle an outbreak investigation by very short training. The contact information collected by this system checked by the Residents and Residency Registration Information System were also very useful for contact management and contact tracing.

In addition, the system was relatively simple and do not require further application systems. It could be run on a laptop or handheld computer and had the advantage of mobility.

The hidden advantage of the Amoebic e-Questionnaires System is the possibility of analyzing the data not only from a single clustering or outbreak, but also chronologically analyzing the same disease, syndrome, and scenarios or individuals.

The experience of Amoebic e-Questionnaires System would be crucial for information systems needed great flexibility, chronologically and epidemiological linkage information.



過濾程式：  
針對與I傳染病所會用到各模組中的題目，自動篩選編排成爲疫情調查表的格式，並且形成幕後傳染病疫情調查資料庫

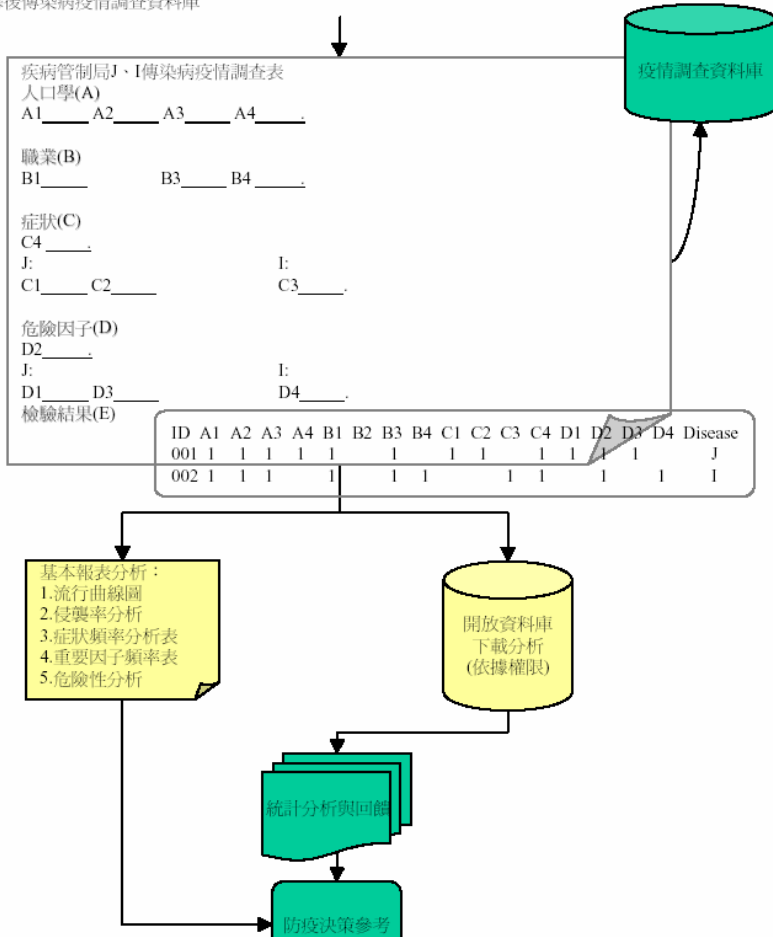


Figure 1. Scheme of Amoebic e-Questionnaire System Data Processing

Table 1. Scheme of Module Question Bank of Amoebic e-Questionnaire System

| No. | Module | Notifiable Disease | Syndrome | Scenario |
|-----|--------|--------------------|----------|----------|
| A1  | A      | J I S              | I II III | X Z      |
| A2  | A      | J I S              | I II     | XY       |
| A3  | A      | J I S              | I III    | YZ       |
| A4  | A      | J                  | I II III | XYZ      |
| B1  | B      | J I S              | II III   | YZ       |
| B2  | B      | S                  | I III    | XYZ      |
| B3  | B      | J I S              | I II     | X Z      |
| B4  | B      | I S                | II III   | XY       |
| C1  | C      | J S                | I II III | X        |
| C2  | C      | J                  | I III    | Z        |
| C3  | C      | I S                | II III   | Z        |
| C4  | C      | J I S              | I III    | X Z      |
| D1  | D      | J S                | I II III | XYZ      |
| D2  | D      | J I                | I II     | XY       |
| D3  | D      | J S                | I III    | YZ       |
| D4  | D      | I S                | II III   | XYZ      |

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