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## Development of the electronic surveillance monitoring system on web applications

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### Abstract

This paper presents the electronic surveillance monitoring system (ESMS) via the web based application used especially for the health sector. The system is created for three purposes, the alert function for the surveillance and rapid response team (SRRT), the monitoring for inspection and evaluation, and the back-office report. With the import and export functions that are capable to retrieve electronic health record and edit the R506 and R507 data, the SRRT and local team can easily set up and manage their resources. The GPS function helps care takers to identify the geographical data for any countermeasure and action. The program is designed to submit reports automatically to the Ministry of Public Health (MOPH). The SRRT module can operate in both on-line and off-line conditions.

*Keywords:* Surveillance monitoring system; Electronic health record; the surveillance and rapid response team (SRRT).

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### 1. Introduction

To achieve the goal for the total health care, World Health Organization (WHO) suggests four health services: the continuum of care, the health promotion, the disease prevention, and the palliative care service. These services are the main key success factor for the concept of health for all and all for health. The concept of health for all basically covers the primary health care and universal health coverage<sup>1</sup>. The ideas for responsiveness, efficiency,

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accessibility and availability are included. On the other hand, the concept of all for health is focused on health literacy, social and financial risk. WHO experts also recommended the care takers to concentrate their additional efforts on surveillance reports and epidemiological surveys in the community level, before moving to the hospital process<sup>2,3</sup>. Both health promotion and the disease prevention require the multidisciplinary team, which combines staffs such as physicians, epidemiologists, nurses, and village head. Stakeholders from hospital levels and community levels must operate together to overcome the diseases under surveillance<sup>4</sup>.

In addition to take a countermeasure from the cause of outbreak, the Ministry of Public Health (MOPH) regulates the protocols and establishes the surveillance and rapid response team (SRRT). SRRT consists of local staffs from MOPH, health volunteer, and community head. When the disease is found either in a hospital or a community, a SRRT team will go to investigate and report back to the hospital and the department of disease control (DDC) at MOPH. All activities, processes and evidences including the outcome must be measured and responded back to headquarter in the sub-region within 72 hours. Moreover according to the guideline, several reports from SRRT and teams must be submitted within 1-3 days to avoid the repeated cycle<sup>5</sup>.

Depending on the situation and disease, some surveillance reports are required to daily process from the SRRT to DDC, where some are weekly. For example the case report for diseases under surveillance 506 and 507 (R506 and R507) is daily requested. Serious epidemiology are required to monitor and response immediately such as Middle East respiratory syndrome coronavirus (MERS-CoV) and swine flu. All infected states must be presented to the centers disease control and prevention (CDC), WHO as agreement in MOU. However, these protocols and reports contains many different sub-system parts in which paper-based documents are basically used, and thus it becomes very difficult and complicated to process and share the data. Many have been informally done and handled carelessly, and thus no evidence could be found or confirmed.

As reports have to send to different departments and organizations, this is a difficult task for the SRRT and epidemiologist teams to catch up with their routine. Many times they fail to process due to the short of mandate. Therefore, for better prevalence and prevention for the surveillance team, this research aims to design the system that can monitor, track, and alert the SRRT team along with other necessary functions such as submitting reports in order to fill the gap and solve the above problems.

## 2. Methodology

The ESMS is an electronic surveillance program designed by using web-based application to connect a SRRT, care providers and epidemiologist teams, and to process all protocols and documents with electronic forms. The concept of the program is to present four modules, the monitoring system, the alert and warning function, the job task system, and the report section. The existing processes and flows have been analyzed. The documents and files used for each process and the types of information are evaluated. The flow starts when the case is found either by a patient visit or a report. Warning and surveillance requests are issued from the epidemiologist team to three local organizations, SRRT, DCC, and municipality from Ministry of Interior (MOI). The case reports from sub-district and the field team are used to identify the priority of problem areas. If outbreak is contaminated, the final report will be sent to the provincial public health office and National Health Society Organization (NHSO). GIS and the web-based programming are added in order to determine the event location and abilities to retrieve the information.

As the design aims to replace the paper-based forms, new electronic record forms were designed for the SRRT and community health care team. All ESMS dataset of patients in the epidemic and surveillance services were simplified based on the process and data flow of R506 and R507 standard formats. All details were collected and analyzed in order to verify the problems and gaps between each informal process, and also to determine the informal documents such as Facebook, Line or Whatsapp. Moreover the connections between the data recorded in their processes were reorganized to minimize the under-coverage problems from the case report. Other problems such as when pandemic was subsided, OPD and IPD nurses only make a direct call to social medicine section for the patient that were sent for PCR were carefully considerate. The new dataset regarding to the new flow and stakeholder were listed as shown in Fig. 1.

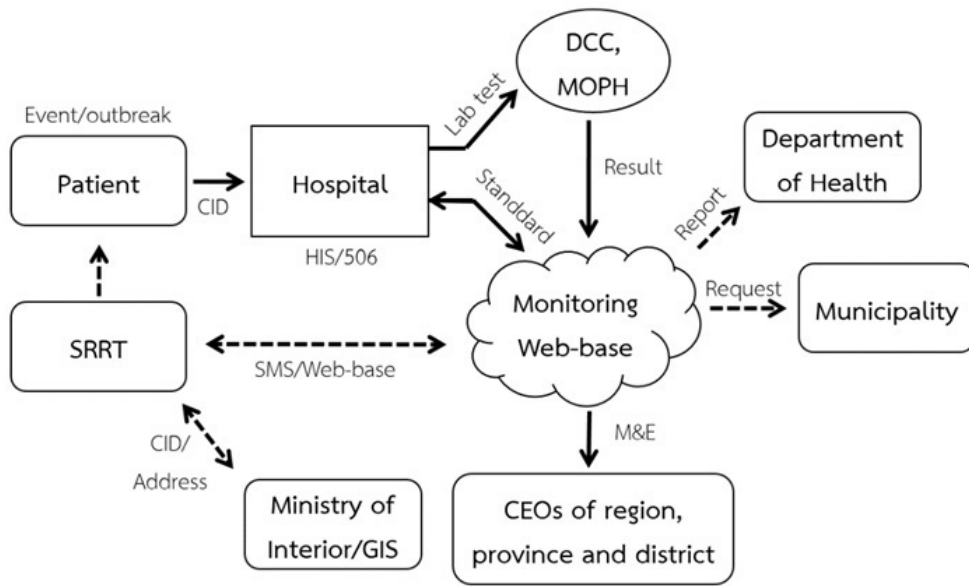


Fig. 1. Data process of the ESMS design.

Qualitative attributes such as simplicity, flexibility, and stability of the new system were verified and compared. In addition the stage, in which sample was send for the laboratory test, was modified to match the requirement from the MOPH headquarter. Instead of having only two laboratory stages, result positive and result negative, the result waiting was added as the third stage. This third stage simply put an ease to the care taker team as it took time for the department of medical science to analyze the simple being sent. Authority for each monitoring process were required as security. This program was designed to be able to import and export electronic health record (EHR) database module from hospital information system (HIS) and the surveillance documents R506 and R507. The new system flow was aimed to improve the completeness and quality of the report and information in the database.

### 3. Result

The experiment results showed that the ESMS has abilities to help SRRT and the community team in the 8th health region. It successfully demonstrated four potentials for a better process as it reduces time and improves an overall performance by taking out the duplicated and informal documents. Many informal processes and documents such as using the social network were reduced. The results from SRRT and surveillance team indicated that with this system the contamination is easier to achieve. As the program allowed the team to manage and operate their work. With the data entry function that could select staff tasks along with their area of responsibility that matched the available resources, provincial public health staffs easily determine and set up the active field team according to the outbreak level. With the HIS-import function, the ESMS is able to fill out the patient forms in a shorter time and thus reduce the mandate and workload for the SRRT and back office.

Moreover, it showed the system effectiveness by warning the local team for data completion of the requested area, and reminding the DDC to analyze the laboratory test. The alert message also set to pop-up when information was missing such as the number identification. This function helped a local team and care provider not to miss typing patient information. The GPS pointed out the demographical data in the event case. The program sent a report back to DDC and region health office in the csv format. Fig. 2 displays the items and functions in the ESMS report module as the dashboard style. All reports from each hospital using this program can successfully sent directly to the provincial public health office, but fail to deliver to National Health Society Organization (NHSO) due to the new data format.

The screenshot shows the R506 Dashboard interface. On the left is a sidebar menu with options: Dash Board, Submit R506, Generate R506, R506 Lists, SRRT Report, R506 Schedule, SRRT Management, Settings, and Options. The main content area is titled 'Generate R506' and includes a 'Submit R506' button. Below this is a section for 'R506 Record Details' with a search bar and a table of records. The table has columns: E0, E1, PE0, PE1, DISEASE, NAME, HN, NMEPAT, SEX, AGEY, AGEM, AGED, and MARIETAL. The first four rows of data are visible.

E0	E1	PE0	PE1	DISEASE	NAME	HN	NMEPAT	SEX	AGEY	AGEM	AGED	MARIETAL
5253	35	0	0	26	John Sandfon	1516801		1	17	0	6	1
5254	1243	0	0	31	Nancy Yuudee	1448911		2	15	0	11	1
5259	1248	0	0	31	Pim Chompoo	1514618		2	46	0	1	2
5262	2703	0	0	02	Kate Sukjai	471809		2	78	0	5	2

Showing 1 to 10 of 25 entries

Fig. 2. The ESMS dashboard and cockpit menu.

#### 4. Conclusion

This ESMS can basically improve an overall performance by enhancing the electronic data into their protocol. The system reduced the human error and usage time from requiring and filling reports from different subsystems. The web application also provided a convenient way to access, edit, and modify data. This system checked null and error in the form before submitting a file which contains the surveillance reports from all hospitals in the 8<sup>th</sup> health region to MOPH and other health organization. The reports generated from this program were mostly the csv format as agreement from the DDC. This saved the back-office team from the troubles as filling documents from the paper-based system was one of the toughest issues due to differences in types and formats. The simplified forms for SRRT and GPS helped the district health officer to manager their team and verify their performance.

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