Outbreak, Surveillance, Investigation & Response (OSIR) Journal
Field Epidemiology Training Program, Division of Epidemiology
Department of Disease Control, Ministry of Public Health, Thailand
Tel: +6625903894, Fax: +6625903845, Email: osireditor@osirjournal.net, http://www.osirjournal.net

Evaluation of the National Tuberculosis Database System, "Tuberculosis Case Management (TBCM)", for its Surveillance Function at Mae Sot Hospital, Thailand

Mohammad Fathi Alikhan[1], Witaya Swaddiwudhipong[2], Farong Xu[3], Dhony Kartika Nugroho[4], Lynn Htut Oo[5], Jit Bahadur Darnal[6], Intan Azura Binti Mhd Din[7], Yu Nandar Aung[8], Ni Win Htike[9], Ba Soe Thet[10], Yamin Thaung[11], Sophanith Ung[12], Anyarat Thiptara[12], Phanthanee Thitichai[13], Pantila Taweewigyakarn[13], Thanit Rattanathumsakul[13], Nichakul Pisitpayat[13], Panupong Tantirat[13], Vanlaya Sreathapranai[13], Rapeepong Suphanchaimat[13,14]*

1 Disease Control Division, Ministry of Health, Brunei Darussalam
2 Mae Sot Hospital, Ministry of Public Health, Thailand
3 Beijing Center for Animal Disease Control and Prevention, People's Republic of China
4 Directorate of Animal Health, Ministry of Agriculture, Indonesia
5 Ayeyarwady Regional Public Health Department, Ministry of Health and Sports, Myanmar
6 Royal Center for Disease Control, Ministry of Health Bhutan, Bhuthan
7 Jasin District Health Office, Ministry of Health Malaysia, Malaysia
8 East District Public Health Department, Yangon, Ministry of Health and Sports, Myanmar
9 Aunglan Township Public Health Department, Ministry of Health and Sports, Myanmar
10 Vector Borne Disease Control Division, State Public Health Department, Ministry of Health and Sports, Myanmar
11 Department of Epidemiology, University of Public Health, Myanmar
12 Svay Rieng Provincial Health Department, Ministry of Health, Cambodia
13 Division of Epidemiology, Department of Disease Control, Ministry of Public Health, Thailand
14 International Health Policy Program, Ministry of Public Health, Thailand

*Corresponding author, email address: rapeepong@ihpp.thaigov.net

Abstract

Thailand is classified by the World Health Organization as one of a few countries in the world with the highest tuberculosis (TB) burden. The Thai Ministry of Public Health has implemented the 'Tuberculosis Case Management' (TBCM) as the main database for the national TB surveillance. TBCM is designed for case registration and management as well as case reporting and notification. This study thus aimed to evaluate TBCM for its surveillance function. A cross-sectional descriptive study was conducted to review the surveillance function of TBCM during 1 Jan to 30 Jun 2017 at Mae Sot Hospital, Thailand. The study team reviewed the protocols and guidelines of TBCM. The practice of health personnel at the TB clinic was observed to determine the data flow of TBCM. Qualitative and quantitative study methods were employed in accordance with the Center for Disease Control and Prevention's Guidelines for Evaluating Surveillance Systems. We found that TBCM reporting system at Mae Sot Hospital was acceptable, stable and useful in achieving the objectives of TB control program. Sensitivity and positive predictive value of TBCM accounted for 80.8% and 99.4% respectively. The most common reason of miss-reporting was a loss to follow-up after admission or after health exam, particularly amongst non-Thai patients. Timeliness and data quality were concerned attributes that required improvement. TBCM and the in-house medical recording system should be harmonized to mitigate the risk of erroneous coding.

Keywords: tuberculosis, surveillance evaluation, sensitivity, positive predictive value, Tuberculosis Case Management

Introduction

Tuberculosis (TB) is a chronic and potentially lethal infectious disease caused by *Mycobacterium tuberculosis*.[1] In 2016, approximately 1.3 million deaths among HIV-negative people were attributable to TB and additional 374,000 deaths among HIV-positive people. It was estimated that about 10.4 million people fell ill with TB in 2016.[1,2] Thailand is classified by the World Health Organization (WHO) as one of the 14 countries in the world with high TB burden. Each year Thailand presents with about 105,000 incident cases.[3] About 16% of the TB cases are HIV positive.[1]

An effective surveillance system is critical to successful disease control.[4] The ultimate goal of TB surveillance system is to reduce the burden of mortality and morbidity from TB by timely identification and comprehensive treatment as management of contacts.[4,5] There are two main TB surveillance systems in Thailand. First is the national disease surveillance system, R506, which is managed by Division of Epidemiology (DOE), Department of Disease Control (DDC), Ministry of Public Health (MOPH). The R506 comprises not only TB, but also, a vast range of communicable diseases. The other is Tuberculosis Case Management (TBCM) system, which is governed by Division of Tuberculosis (DTB), DDC, MOPH and specifically designed for TB.[6]

It is pertinent that TBCM should be evaluated periodically. In this regard, we used Mae Sot Hospital as a case study to evaluate TBCM for its surveillance function. Mae Sot Hospital is located in Mae Sot, Tak. It is the residence for Thai population, numbering about 150 thousand and non-Thai populations, mostly, Myanmar, numbering about 130 thousand. Mae Sot Hospital is a 420-bedded general hospital. In 2017, there were 185 TB cases amongst Thai Nationals and 136 TB cases amongst non-Thais. The treatment success rate was 87.1% amongst Thais and 81.1% amongst non-Thais.

The objectives of this study are to (i) describe tuberculosis management system at Mae Sot Hospital, (ii) assess the surveillance function of TBCM at Mae Sot Hospital, and (iii) to provide recommendation to improve tuberculosis management system at Mae Sot Hospital. It is hoped that this study can serve as a meaningful lesson for improving TB surveillance for other provinces in Thailand and in other countries with relatively similar context.

Methods

Study Design

We applied a cross-sectional descriptive study. The field data collection was conducted from 31 Jul to 3 Aug 2018. The frame of the evaluation was adopted from 'Updated guidelines for evaluating public health surveillance systems', recommended by the Centers for Disease Control and Prevention (US-CDC).[7]

Study Period

The period of interest was between 1 Jan to 30 Jun 2017.

Population Scope

For qualitative attributes, we collected data by interviewing all persons involved with TBCM in Mae Sot Hospital. For quantitative attributes, we collected data from the medical records, e.g., TB treatment card, outpatient department (OPD) card, and inpatient department (IPD) charts stored in Mae Sot Hospital.

Data Collection Methods and Tools

Qualitative attributes

We reviewed the protocols and guidelines of TBCM in Thailand. The practice of staff at TB clinic of Mae Sot Hospital was observed to enable the team to understand the data flow and the patient flow. In-depth interviews using semi-structured questionnaires were conducted on 13 respondents in the hospital. The interviews were audio taped and transcribed upon verbal consent from the interviewees.

Quantitative attributes

Medical records in inpatient (IP) and outpatient (OP) wards were reviewed. Laboratory and drug logbooks were explored. We also checked health-examination data of migrants from migrant-worker clinic of Mae Sot Hospital. Then we assessed these data against the records in TBCM.

Operational Definitions

A patient would be identified as TB case if he/she was found to meet either of the following criteria: (i) diagnosed as TB by a physician with either one of the following ICD-10 (the 10th revision of the International Classification of Diseases) codes: A15, A16, A17, A18, and A19; (ii) showing positive TB results from either one of the following tests: sputum smear, sputum culture, Xpert MTB/RIF, and Line Probe Assay (LPA); (iii) receiving rifampicin or kanamycin for treating TB, and (iv) showing positive chest radiograph compatible with TB from the health examination at migrant-worker clinic.

Data Analysis

We narratively described the flow of patients suspected of TB and the flow of TB data in the hospital. Then we described usefulness of the system based on the interviews. We applied content analysis for qualitative data and descriptive statistics for quantitative data. For qualitative attributes, we focused on acceptability, flexibility, simplicity and stability. For quantitative attributes, we focused on quality of reporting (completeness and validity), timeliness, sensitivity, positive predictive value (PPV), and representativeness. Details of the quantitative attributes are displayed in Table 1.

We also investigated reasons of miss-reporting by reviewing the medical records and interviewing with the physicians in charge.

Table 1. Definition of quantitative attributes

Attribute	Definition
Data quality	
i. Completeness	No missing of each key variable in TBCM
ii. Validity	Accuracy of selected variables in TBCM, assessed against medical charts
Timeliness of reporting	Time interval between diagnosis and reporting the results to TBCM
Sensitivity	Proportion of the total number of cases in the population under surveillance being detected by TBCM
Positive predictive value	Proportion of cases reported to TBCM that met the case definition of TB
Representativeness	Comparison of the characteristics of cases reported to TBCM with TB cases presenting at Mae Sot Hospital

Ethics Consideration

This research was conducted as part of the routine evaluation of the DOE. Hence ethics clearance was not needed. However, the researcher team always followed research ethics standards. All individual information was anonymised.

Results

Flow of Patient and Data

Figure 1 below shows an overview of patient flow and data flow of TB cases in Mae Sot Hospital. A patient can be diagnosed from general OPD, inpatient wards or specialist departments as well as private facilities and migrant-worker clinic. Initial treatment can either be given as an inpatient or an outpatient based on clinical severity. Meanwhile the data flow started from the TB clinic with the notification of a TB patient. The reporting was performed by a TB clinic officer into TBCM online system. Data from TBCM were exported from the epidemiology unit to the TB coordinators for case management as well as data validation and verification and to Division of Tuberculosis, DDC, for data aggregation.

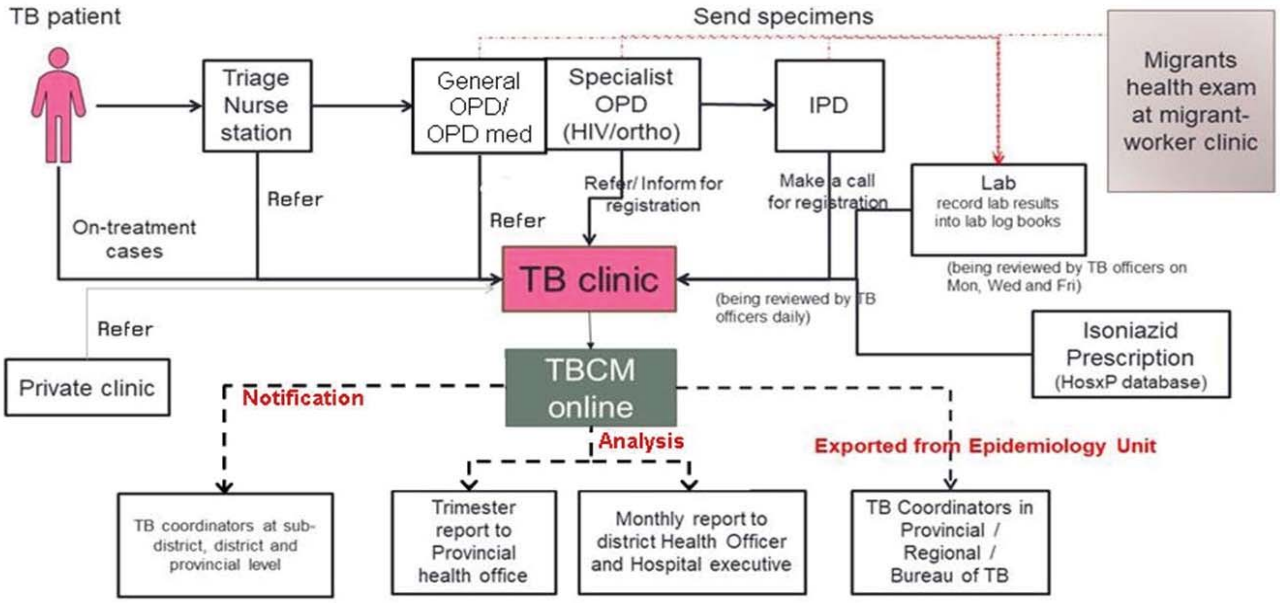

Figure 1. Flow of services for TB patients and data of TB cases at Mae Sot Hospital

Usefulness of TBCM

All of the respondents agreed that TBCM surveillance system helped identify high risk population for active screening and optimize the treatment to match each individual patient's health need.

"Treating TB is an art. Sometimes, I cannot follow the guideline and I need to change the treatment for complicated patients. I used data from personal TB records (from TBCM) to design strategy to take care of TB patients. I can easily ask it from TB manager."…Infectious disease specialist

Qualitative Attributes

Overall, the participants presented relatively positive attitudes towards most qualitative attributes, excepting flexibility. Table 2 displays the results from content analysis on qualitative attributes.

Simplicity

About 64% (7/11; excluding participants coded as 'not applicable') of the respondents reported that the system was simple and user friendly, while approximately a quarter informed that the system was not simple because it had no linkage with other existing reporting systems (such as HOSxP).

"Everything would be easier if all databases were linked together."…Laboratory officer

Acceptability

About 92% (11/12) of the interviewees responded that the system was acceptable and the system also helped them to access the data easily. However, one of the interviewees pointed that the system was less acceptable as part of it required manual entry, which was quite burdensome.

Table 2. Summary of content analysis findings on qualitative attributes

No. of interviewee	Position	Simplicity	Acceptability	Stability	Flexibility
1	Hospital director	1	1	1	-1
2	Infectious disease specialist	1	1	1	-1
3	Doctor in charge of IP care	-1	1	0	NA
4	Nurse in charge of IP care	NA	1	NA	NA
5	Epidemiologist	-1	1	0	-1
6	Paediatrician	NA	NA	NA	NA
7	Paediatric nurse	1	1	NA	NA
8	Laboratory officer	-1	-1	1	-1
9	IT officer (hospital)	1	1	1	0
10	IT officer (TB clinic)	1	1	1	1
11	TB officer/manager	0	1	1	-1
12	TB nurse	1	1	1	1
13	TB health worker	1	1	1	1

Note: 1=Positive attitude, -1=Negative attitude, 0=Neutral, NA=Not applicable, IT=Information and technology

Stability

Four-fifths (8/10) of the respondents viewed that the system was stable because they had back-up plans to support its operation, such as manpower and standard operating procedures. Nobody viewed that the program would be terminated soon since the system was supported by the MOPH.

Flexibility

One-third (3/9) of the respondents mentioned that TBCM was flexible in terms of data reporting as it allowed the officers to edit the individual patient data. However, about half of the respondents (5/9) mentioned that the system was not flexible as they could not edit certain variables online.

Quantitative Attributes

Sensitivity

It is found that of 203 cases that met case definition of TB during the study period, 164 were reported in TBCM. This meant the sensitivity of reporting equated 80.8%.

Positive predictive value

We found that there were 165 cases presented in TBCM. Of these 165 records, 164 met the case definition of TB. This denoted that PPV accounted for 99.4%, Table 3.

Table 3. Presence of records in Tuberculosis Case Management by assessing against the case definition

	Meet case definition	Do not meet case definition	Total
Present in TBCM	164	1	**165**
Not present in TBCM	39	147	**186**
Total	**203**	**148**	**351**

Completeness

Completeness of TBCM in most of the variables, such as, date of birth, gender and sites of infection, was extremely high. However, there were some variables with incomplete recording, particularly, date of treatment starting (84%) and telephone number (52%), Table 4.

Table 4. Completeness of variables in Tuberculosis Case Management, assessed against hospital records

Variable	No. of complete records (N=321)	Percentage
Date of birth	321	100%
Gender	321	100%
Pulmonary/ extra-pulmonary	321	100%
Type of registration (New/relapse)	321	100%
Subdistrict address	315	98%
Date of treatment start	271	84%
Telephone number	166	52%

Validity

Validity was checked by comparing the data in hospital records (HOSxP) against the data in TBCM. Data from the hospital records were used as gold standard. Gender, age and site of infection presented with the largest degree of validity. Treatment and address data showed relatively low percentage, Table 5.

Table 5. Validity of variables in Tuberculosis Case Management, assessed against hospital records

Variable	Number of records with matched variables (N=164)	Percentage
Gender	161	98%
Age	147	90%
Pulmonary/ extra-pulmonary	142	87%
Date of treatment	102	62%
Subdistrict address	109	66%
Identification number	84	51%

Timeliness

Timeliness was assessed by measuring lag time between diagnosis date and reporting date. According to TBCM guideline, a newly diagnosed TB patient should be reported to TBCM within 7 days after diagnosis. Among 164 reports with complete data, 48% of the TB patients in Mae Sot (62/129) met the 7-day benchmark. If the cut-off was extended to 14 days, 71% of the records (92/129) demonstrated timely reporting.

Representativeness

The records in TBCM were almost identical to those in medical charts; for instance, mean age of the patients in TBCM was 47 years, just a year greater than that in medical charts. The most remarkable difference was found in nationality variable (about 5%-margin), Table 6.

Table 6. Representativeness of variables in Tuberculosis Case Management, assessed against hospital records

Characteristic	Reported in medical charts	Reported in TBCM
Age (mean ± standard deviation)	46±18	47±18
Male to female ratio	1.5:1	1.7:1
Sub-district (%) (n/N)		
• In Mae Sot	74% (129/203)	72% (118/165)
• Outside Mae Sot	26% (74/203)	28% (47/165)
Nationality (%) (n/N)		
• Thai	48% (98/203)	53% (87/165)
• Non-Thai	52% (105/203)	47% (78/165)
Sites of infection		
• Pulmonary	87% (176/203)	87% (143/165)
• Extra-pulmonary	13% (32/203)	13% (22/165)

Exploring Reasons of Non-reporting in TBCM

We reviewed medical records to identify reasons of miss reporting of TB cases. There were 39 patients who met TB case definition but were not reported in TBCM. Of these patients, 28 lived outside Mae Sot. Miss-reporting occurred mostly in non-Thai populations, comprising refugees from temporary shelters or cross-border immigrants. The reasons of miss-reporting varied. Loss to follow-up was the most common reason. Some other reasons included being diagnosed as TB for the first time in other hospital units outside TB clinic (e.g., paediatric or orthopaedic units) or death during admission before being reported in TBCM, Table 7.

Table 7. Reasons of miss-reporting in Tuberculosis Case Management

	Residing in Mae Sot (N=11)	Not residing in Mae Sot (N=28)
Thais (N=11)	- Reason unidentified (n=1)	- Loss to follow-up after treatment (n=4) - Died soon after diagnosis (n=1) - Treated at orthopaedic and paediatric wards (n=1) - Reason unidentified (n=4)
Non-Thais (N=28)	- Loss to follow-up after admission (n=2) - Loss to follow-up after migrant health exam (n=2) - Referred to Myanmar (n=2) - Died soon after diagnosis (n=1) - Reason unidentified (n=3)	- Residing in Myanmar (n=4) - Residing in sheltered areas of refugees (n=4) - Referred to other hospitals (n=2) - Treated at orthopaedic ward (n=1) - Reason unidentified (n=7)

Discussion

This study has shed light on the performance of TBCM reporting system at Mae Sot Hospital. Overall, most participants found that TBCM was helpful in terms of resource planning and situation monitoring. Sensitivity and PPV of the system accounted for 80.8% and 99.4%.

These figures are quite satisfactory as they are way greater than the TB surveillance system elsewhere, for instance, 68% sensitivity and 10% PPV in Afghanistan[8] and 27% sensitivity and 7% PPV in Ghana.[9] This might be because Afghanistan and Ghana were low- and middle-income nations where the health system is not yet well established compared with Thailand, which is an upper-middle nation.[10,11]

Our study also found that the quality of data needs improvement in certain variables, for example, nationality, date of treatment, and sub district address. Though, these variables are optional fields for the data entry process of TBCM, they can provide helpful information in monitoring the progress of disease and treatment outcomes. This information coincides with the findings for qualitative attributes; simplicity in particular. To date, the transferring of data from the hospital's electronic medical chart (HOSxP) into TBCM still requires manual entry as HOSxP and TBCM are not automatically linked. There was also a participant pointing that TBCM should allow flexibility in editing some variables. However, this issue needs a deliberate consideration. This is because TBCM is the national database. Hence, it needs to maintain a standardisation of variables across settings (though in the future the developer may improve TBCM by allowing local providers to edit certain variables which do not affect the whole system).

Timeliness of reporting is also important, as delay in reporting can cause delay in prevention and control measures especially in detecting outbreaks or clusters of cases.[7] We found that only half of the cases were reported to TBCM in a timely manner. This discovery coincides with the situation elsewhere. The Ghanaian review found that only 55.6% were reported in a timely manner to the regional level.[9] The delay in reporting might result from many factors, not only a pitfall of TBCM by itself. The hospital staff should consult among each other to identify the root cause of this problem and propose optimal measures to address this issue. For instance, a shortcut communication from the station of diagnosis to the point of data entry should be made in order to speed up the reporting of cases to TBCM.

Another point that is worth mentioning is the miss-reporting of the cases in TBCM. The most common reason was a loss to follow-up. This explanation was logical as the diagnosis of TB sometimes took a long time until the sputum smear or Xpert MTB/RIF results came out, and this requires more than one hospital visit. Hence it is possible that the diagnosis at the first visit of the patient might not meet TB case definition (and the record was not reported to TBCM from the outset) but later the laboratory result showed up as TB. This phenomenon warrants not only the improvement of TBCM reporting system, but the case management of the hospital as a whole. A system to trace and identify contact information of the patients should be in place.

Limitations

There remain some limitations in this study. First, this study is limited to the TB surveillance system in Mae Sot Hospital only. The readers should be cautious in generalising the findings to other settings. Second, the volume of interviewees was quite small. Some participants involved in TB management did not participate in the interview, such as nurses and public health officers at health centres. Third, we had not explored patients with diseases which had clinical course close to TB, such as chronic bronchitis or lung cancer. A more thorough evaluation should incorporate those diseases in the future.

Public Health Recommendations

The TB surveillance system of Mae Sot Hospital should be improved by arranging a training session for hospital staff involved in the TBCM reporting system, especially in the perspective of timeliness and data quality. A case management system that helps track all patients suspected of TB or those awaiting the laboratory results should be introduced in order to minimize the risk of loss to follow-up. Data scientists in charge of TBCM software development of the DDC should work closely with the information-and-technology officers at local hospitals to harmonize TBCM with the in-house medical recording system. This practice also helps mitigate erroneous coding by manual entry.

Acknowledgements

The team would like to thank all the staff at Mae Sot Hospital and all colleagues in DOE for their assistance with the project.

Suggested Citation

Alikhan MF, Swaddiwudhipong W, Xu F, Nugroho DK, Oo LH, Darnal JB, et al. Evaluation of the national tuberculosis database system, "Tuberculosis Case Management (TBCM)", for its surveillance function at Mae Sot hospital, Thailand. OSIR. 2021 Mar;14(1):20-6.

References

1. Falzon D, Schünemann HJ, Harausz E, González-Angulo L, Lienhardt C, Jaramillo E, et al. World Health Organization treatment guidelines for drug-resistant tuberculosis, 2016 update. Eur Respir J. 2017 Mar 22;49(3):1602308.
2. Migliori GB, Raviglione MC, Schaberg T, Davies PD, Zellweger JP, Grzemska M, et al. Tuberculosis management in Europe. Task Force of the European Respiratory Society (ERS), the World Health Organisation (WHO) and the International Union against Tuberculosis and Lung Disease (IUATLD) Europe Region. Eur Respir J. 1999 Oct;14(4):978-92.
3. World Health Organization. Global Tuberculosis Report [Internet]. Geneva: WHO; 2020 [cited 2021 Feb 24]. <https://apps.who.int/iris/bitstream/handle/10665/336069/9789240013131-eng.pdf>.
4. Jamison D, Breman J, Measham A, Alleyne G, Claeson M, Evans D, et al. Disease Control Priorities in Developing Countries. 2nd ed. Jamison D, Breman J, Measham A, Alleyne G, Claeson M, Evans D, et al., editors. Washington DC: International Bank for Reconstruction and Development/ World Bank/ Co-published by Oxford University Press; 2006.
5. Lee LM, Thacker SB. Public health surveillance and knowing about health in the context of growing sources of health data. Am J Prev Med. 2011 Dec;41(6):636-40.
6. Bhatia V. rGLC Country Support Mission Report [Internet]. New Dehli: WHO SEARO; 2018 [cited 2020 Aug 28]. <https://www.who.int/docs/default-source/searo/tuberculosis/rglc-report-thailand-2018.pdf?sfvrsn=af5b12_2>.
7. German RR, Lee LM, Horan JM, Milstein RL, Pertowski CA, Waller MN. Updated guidelines for evaluating public health surveillance systems: recommendations from the Guidelines Working Group. MMWR Recomm Rep. 2001 Jul 27;50(RR-13):1-35.
8. Saeed KM, Bano R, Asghar RJ. Evaluation of the national tuberculosis surveillance system in Afghanistan. East Mediterr Health J. 2013 Feb;19(2):200-7.
9. Frimpong-Mansoh RP, Calys-Tagoe BNL, Therson-Coffie EF, Antwi-Agyei KO. Evaluation of the tuberculosis surveillance system in the Ashaiman municipality, in Ghana. Pan Afr Med J. 2018 Oct 19;31:126.
10. World Health Organization. Regional Office for the Western Pacific. The Kingdom of Thailand health system review. Manila: WHO Regional Office for the Western Pacific; 2015.
11. Patcharanarumol W, Tangcharoensathien V, Limwattananon S, Panichkriangkrai W, Pachanee K, Poungkantha W, et al. Why and how did Thailand achieve good health at low cost? In: Balabanova D, McKee M, Mills A, editors. 'Good health at low cost' 25 years on What makes a successful health system. 1st ed. London: London School of Hygiene & Tropical Medicine; 2011. p. 193-223.