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Evaluation of Three Main Tuberculosis Case Reporting Systems in Satun Province, Thailand, 2011

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Abstract

Three main tuberculosis (TB) reporting systems were operating in Thailand: notifiable disease surveillance (R506), TB registration and control in Bureau of Tuberculosis (BTB) and TB report for reimbursement in National Health Security Office (NHSO). A cross-sectional study was conducted in Satun Province in July 2011 to determine whether the three systems responded well to the objectives of TB surveillance. Patients diagnosed with TB and received anti-TB drugs at least once in 2010 from three hospitals were compared with TB cases reported in three systems. In the hospitals, 170 TB cases, including 95 new smear positive pulmonary TB cases, were reviewed. Coverage and positive predictive value were 73% and 83% for R506, 87% and 100% for BTB, and 79% and 99% for NHSO respectively. Success rate (82%) of all cases was lower than that was reported in BTB (96%). Median duration from diagnosis to reporting in R506, BTB and NHSO were six, 61 and two days respectively. All systems had sufficient budget, human resources and regular training. In addition, all systems had good capacity to achieve the major objectives of TB surveillance and their specific objectives. However, the systems had total 295 variables which resulted in high workload for reporting. Integrating three systems as one national TB reporting system was recommended to improve coverage, timeliness and success rate.

Key words: tuberculosis, surveillance, evaluation, Thailand

Introduction

Tuberculosis (TB) is a chronic and potentially lethal infectious disease caused by *Mycobacterium tuberculosis*, with over nine million new infections and 1.7 million deaths every year, including 230,000 HIV-associated TB cases.[1,2] Surveillance is a critical component for successful TB control.[3-5] Major aims and objectives of TB surveillance were generally designed to reduce burden of mortality and morbidity from TB by identification and treatment of cases as well as management of contacts. A well developed surveillance system could also help to detect outbreaks and evaluate treatment and prevention programs.[4-7]

There were three main TB reporting systems in Thailand conducted by Bureau of Epidemiology (BOE), Bureau of Tuberculosis (BTB) and National Health Security Office (NHSO) (Figure 1).[8,9] TB surveillance conducted by BOE was based on the notifiable diseases surveillance system (R506) which reported data on the Morbidity Notification Card 506. Only new patients with acid-fast bacilli (AFB) positive on a sputum smear were reported by the R506 system.[9] The BTB had the national registration system with its own reporting forms for TB treatment and control.[8] The TB reporting system in NHSO collected data for reimbursement of TB diagnosis and treatment in Universal Coverage Scheme since 2007.[9]

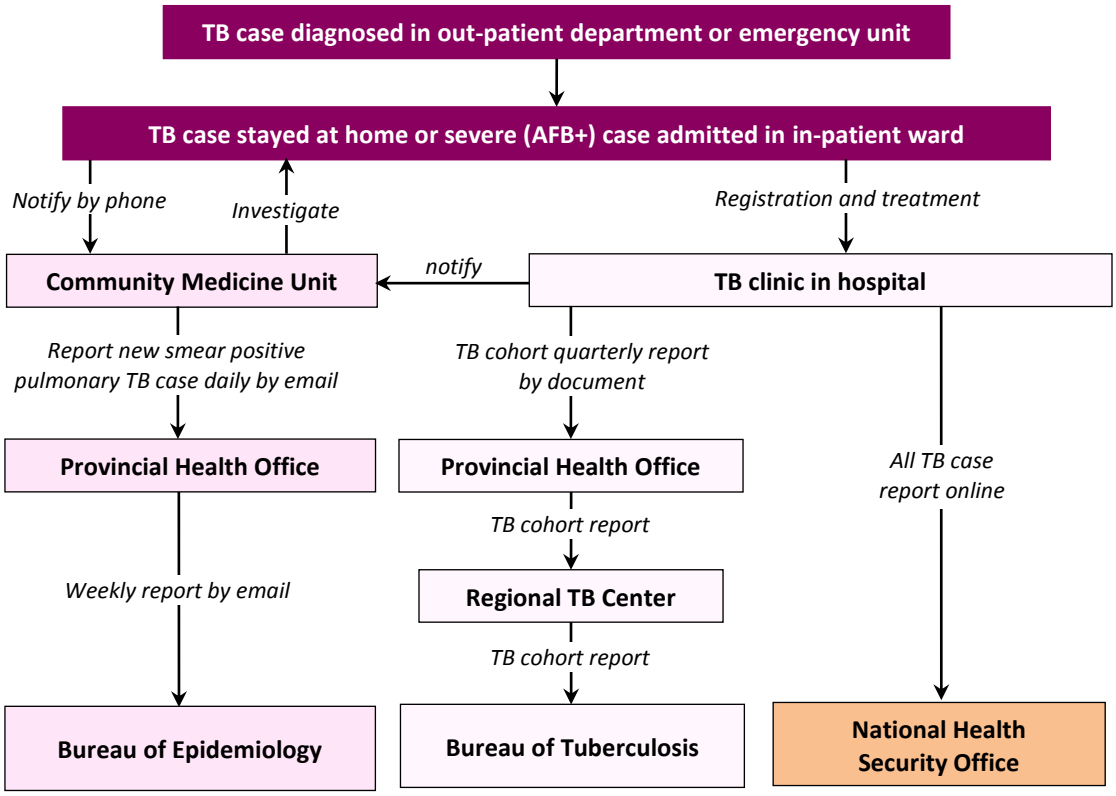

Figure 1. Workflow of 3 tuberculosis reporting systems in Satun Province, Thailand, 2010

The TB surveillance systems should be evaluated periodically to ensure the systems meet their objectives of TB surveillance, and improve quality, efficiency and usefulness.[6,9,10] Moreover, these systems had never been simultaneously evaluated. A cross-sectional study was conducted in Satun Province in July 2011 to determine whether the systems responded well to the objectives of TB surveillance and fulfilled their specific objectives. This study would be meaningful in improving TB surveillance and control in Thailand and also in other countries with similar situation.

Methods

Study Sites

This study was conducted in Satun Province of Thailand in July 2011. Satun Province is located in the southern part of Thailand and close to the Thailand-Malaysia border with vibrant population and migration. Hospitals with scales of 30, 60 and 90 beds and new TB cases reported in R506 during 2010 were included in this study. Three hospitals with the highest number of TB cases in 2010 were selected from total six hospitals in the province, including Satun Provincial Hospital, La-ngu District Hospital and Khuan Don District Hospital.

Case Definition

A TB case was a patient diagnosed as TB by a physician and received anti-TB treatment at least one time in one of the studied hospitals during 2010.[12,13] Exclusion criteria included TB cases referred to another hospital, diagnosis changed from TB to other diseases, foreigners or prisoners with TB, and contacts who received anti-TB drugs for preventive treatment. A new smear positive pulmonary (new M+) TB case was a new pulmonary TB patient with at least one time smear positive in three different sputum samples for acid-fast bacilli (AFB) testing during the first month after diagnosis.

Sample Size

The World Health Organization (WHO) reported that case detection rate (CDR), the proportion of notified incident cases, for all TB cases in Thailand was estimated as 69%[13] which was used to estimate sample size for sensitivity of case reporting. As no estimates were available for positive predictive value (PPV), 50% was used to obtain the largest sample size.[14] The sample size was calculated to estimate sensitivity and PVP within 10% of the true value, using 95% confidence interval (95% CI) and α as 0.05. Total number of cases reported by R506 system in 2010 was 100, which was considered as the population for PVP, and population for sensitivity was 145 (100/0.69).

Quantitative Data Collection

Medical records of TB cases in three hospitals were reviewed and compared with data from the reporting

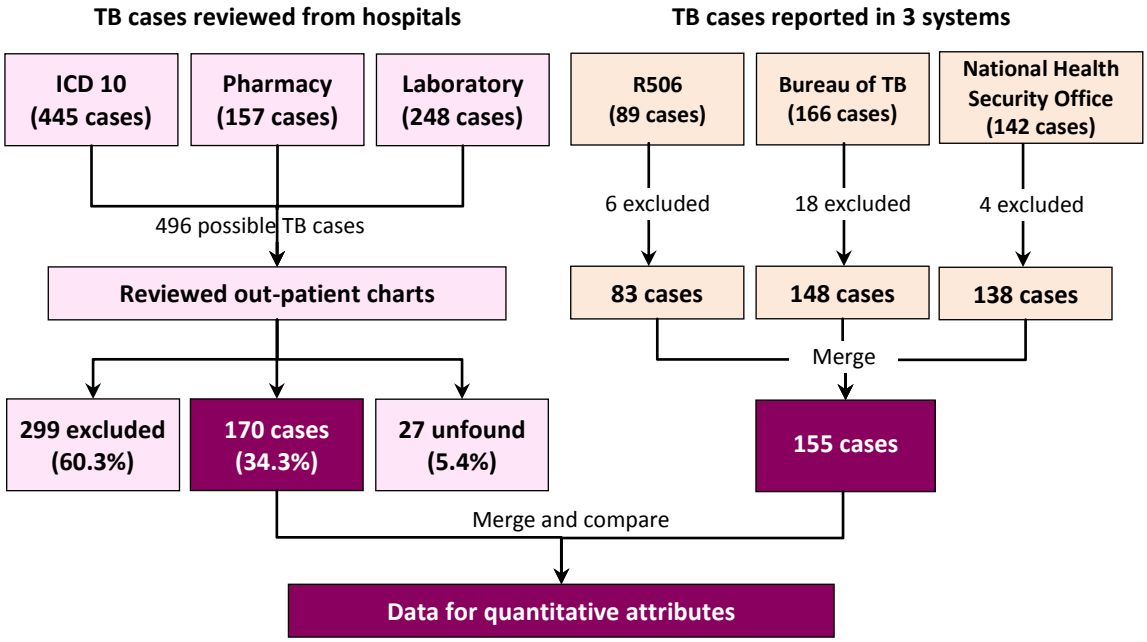

Figure 2. Tuberculosis cases reviewed from 3 hospitals and reported in 3 reporting systems, Satun Province, Thailand, 2010

systems (Figure 2). A possible TB case was a patient diagnosed as TB in one of the three hospitals during 2010 and met one of the following conditions: 1) 10th revision of the international classification of diseases (ICD-10) code of A15 (respiratory TB confirmed by bacteriologically and histologically), A16 (respiratory TB, but not confirmed bacteriologically or histologically), A17 (TB of nervous system), A18 (TB of other organs), A19 (miliary TB), B20.0 (HIV disease resulting in TB) or B90 (sequelae of TB);[11] 2) a patient recorded for receiving anti-TB drugs in logbook of hospital pharmacy; 3) a patient recorded as positive sputum smear in logbook of hospital laboratory. Then, possible cases were searched from ICD-10 data, pharmacy and laboratory logbook (Figure 2), and matched with charts from out-patient department (OPD) by hospital number to determine whether they met the TB case definitions.

Data reported by the hospitals in 2010 were also collected, including cases reported in R506, NHSO, and TB03 form, TB07 quarterly form, TB07/1 laboratory result form and TB08 treatment outcome form of BTB.

Qualitative Data Collection

Total 31 staff from central, regional, provincial health office (PHO), district health offices (DHO), health center and hospitals was interviewed by semi-structured questionnaires, including five policy makers, one physician, three laboratory officers, three pharmacists, 14 reporting officers, two medical statisticians and three public health officers.

Indicators for Qualitative and Quantitative Attributes

Workflow and operation of three TB reporting systems in Satun Province were assessed. Data quality, coverage, PPV, multi-drug resistance TB (MDR-TB) and treatment outcome were evaluated by analyzing data reviewed from the hospitals and the reporting systems (Table 1).[15-17] Case notification rate in a district was calculated as dividing number of cases reviewed from a hospital by number of mid-year population in district that the hospital was located. In addition, capacity and support, TB screening and contact tracing, simplicity, stability and usefulness were summarized from the interview (Table 1).[7,17]

Statistical Analyses

Quantitative data was transformed into a computerized data set. The Kruskal-Wallis rank test was performed to compare timeliness of report in the hospitals and 2-sided p-values were reported with a significance level of less than 0.05.

Results

Overview of TB Reporting Systems

Figure 1 showed how a patient diagnosed with TB was reported to R506, BTB or NHSO systems. As for R506, information of new M+ cases with 35 variables was reported to PHO by email, and much effort was needed to summarize the data every week and check for duplicated records. In BTB, a reporting center with physician, nurse, pharmacist and assistant was in TB clinic. Forms used in BTB included TB01 and TB03 with 39 variables for case registration, TB07

Table 1. Main attributes used for evaluating 3 tuberculosis reporting systems in Satun Province, Thailand, 2010

No.	Attribute	Definition	R506	Bureau of TB	National Health Security Office
	Qualitative Attributes				
1.	Description of system	Objective, flow and operation of each system	✓	✓	✓
2.	Simplicity	Structure and ease of operating each system, considering amount and type of data, and methods of collecting, reporting, analyzing and disseminating data	✓	✓	✓
3.	Stability	Reliability (the ability to collect, manage and provide data properly without failure) and availability (the ability to operate) of each system	✓	✓	✓
4.	Identification and management of contact	Identification, tracing and managing contacts of pulmonary TB cases in surveillance	✓		
5.	Program capacity and support	Ability and support (organization, staffing, resources and facilities) to carry out the core components of each system	✓	✓	✓
6.	Usefulness	The real "action taken" as a result of the data obtained from 3 systems	✓	✓	✓
	Quantitative Attributes				
7.	Data quality				
	- Completeness	Completeness of key variables	✓	✓	✓
	- Duplication	Proportion of duplicated cases in systems	✓	✓	
	- Accuracy	Accuracy of age, type of patient and treatment outcome in systems	✓	✓	
8.	Coverage				
	- Coverage of all TB cases	Proportion of all TB cases reported in each system		✓	✓
	- Coverage of new smear positive pulmonary (new M+) TB cases	Proportion of new M+ TB cases reported in R506	✓		
9.	Positive predictive value (PPV)	Proportion of cases that meet the TB case definition of this study among reported cases in each system	✓	✓	✓
10.	Timeliness				
	- Timeliness of report	Time interval between diagnosis and reporting to each system	✓	✓	✓
	- Timeliness of treatment	Time interval between diagnosis and first anti-TB treatment in Bureau of TB and National Health Security Office		✓	✓
11.	Treatment effects				
	- Conversion rate	Proportion of AFB negative at 2nd month of treatment among new M+ TB cases[12, 20]		✓	
	- Success rate	Proportion of cases cured or completed treatment[12]		✓	

with 37 variables for summarizing data based on TB03, TB07/1 with 40 variables for reporting sputum conversion rate after TB07 for six months, TB08 with 40 variables for reporting treatment outcome after TB07 for one year. The regional TB center gave feedback to PHO which also provided it again to TB clinic in the hospitals, based on the data from BTB. For NHSO, clinicians in Satun Hospital and Khuan Don Hospital reported data online with 104 variables. The central office of NHSO reimbursed the hospitals

every three months according to the data reported. In addition, regional NHSO could extract summary data from the central office quarterly or annually.

TB Screening and Contact Tracing

According to the interviews, policy makers placed a high priority on TB case screening for surveillance and control. Patients diagnosed of diabetes, chronic obstructive pulmonary disease (COPD), asthma or HIV with cough more than two weeks and patients with hemoptysis or productive cough were routinely screened by sputum smear for AFB and/or chest X-ray in the hospitals. The TB screening campaign for migrant workers and Thai residents in Satun was conducted once in 2010.

Data from R506 could be used for contact tracing. Active contact tracing was conducted by DHO and health centers with criteria by age groups. Investigation form was used for contact identification in Satun and Khuan Don Hospitals. However, data collection and analysis of contact tracing were not systematic.

Reviewing and Reporting of Cases

A total of 496 possible TB cases were identified from the hospitals, and 170 cases (34.3%) met the definition of TB case, including 95 new M+ cases (Figure 2). Total 299 possible cases were excluded, including patients diagnosed before or after 2010 (57.2%), suspected TB patients without AFB positive results (15.7%) and cases referred to hospitals in other district or province (13.4%). Case notification rate of all TB cases and new M+ in three districts during 2010 were 95 and 53 per 100,000 population respectively. Total 83, 148 and 138 cases were reported in R506, BTB and NHSO respectively (Figure 2).

Quality of Data

Completeness of data in three systems were 100% for key variables which included name, gender, age, address, diagnosis date, reporting date and type of patient. In NHSO, it was also 100% reporting for the variables of number, gender and registration date. However, completeness of some variables reduced with time course of disease, including 99% for diagnosis date, 89% for treatment date, 58% for sputum conversion result and 56% for treatment outcome. Although R506 had one duplicated case, TB03 in BTB had none. Duplication in NHSO could not be checked as there was no patient's name in the report. Compared to data reviewed from the hospitals, accuracy of age, type of patient and treatment outcome in BTB were 87.8% (129/147), 91.8% (134/146) and 83.3% (115/138) respectively while accuracy of age in R506 was 85.2% (69/81).

Median duration from diagnosis to reporting in R506 was significantly different in the hospitals. Satun Hospital had the shortest duration with three days, followed by La-ngu Hospital and Khuan Don Hospital with 52 and 55 days respectively (Table 2). However, Satun Hospital needed longer time (10 days) than the other two hospitals to report to BTB. Although timeliness of reporting was not significantly different in NHSO, this system took a long time to input data due to total 104 variables and low internet speed.

Coverage and PPV

Coverage of all TB cases in the merged database of three systems was 88.8% (151/170). Coverage of new M+ cases in R506 was 72.6% (69/95) while coverage of all cases was 87.1% (148/170) in BTB and 79.4% (135/170) in NHSO. PPV of all cases was 98.8% (82/83) in R506, 100% (148/148) in BTB and 97.8% (135/138) in NHSO. However, PPV for new M+ case in R506 was 83.1% (69/83).

Culture and Testing for Multi-drug Resistance

A total of 37.1% (63/170) of all TB cases and 60.0% (57/95) of new M+ cases diagnosed in 2010 had sputum cultures, including 86.0% (49/57) of new M+ cases from Satun Hospital, 24.1% (7/29) from La-ngu Hospital and 11.1% (1/9) from Khuan Don Hospital. Duration between sending specimen and receiving result was normally 2-5 months. Among 63 cases with sputum cultures, 58 cases got drug sensitivity results,

Table 2. Duration between diagnosis and reporting to 3 tuberculosis reporting systems in Satun Province, Thailand, 2010

Hospital	R506[1]		Bureau of TB[2]		National Health Security Office[3]	
	Number of case	Median day (P_{25},P_{75})	Number of case	Median day (P_{25},P_{75})	Number of case	Median day (P_{25},P_{75})
Satun Hospital	47	3 (2,5)	78	10 (7,17)	70	2 (1,12)
La-ngu Hospital	23	52 (29,88)	41	1 (0,8)	37	1 (0,8)
Khuan Don Hospital	10	55 (20,98)	13	3 (2,5)	9	4 (2,8)
Total	80	6 (2,40.5)	132	8 (1.5,16)	116	2 (0,9)

[1] *Chi-square = 41.6, p-value <0.001* [2] *Chi-square = 26.1, p-value <0.001* [3] *Chi-square = 2.1, p-value = 0.35*

with 20.7% (12/58) resistance to isoniazid and 5.2% (3/58) to rifampicin. Three cases resistance to both isoniazid and rifampicin were MDR-TB. Three out of four cases (75.0%) who had AFB positive after two months were cultured.

Treatment Outcome

Conversion rate of all TB cases reviewed from the hospitals were 95.7% (89/93), which was quite close to 96.7% (88/91) reported in BTB (TB07/1). Out of 155 cases who completed treatment, 55.5% cases were cured and 21.3% had complete treatment while others were loss to follow up (11.0%), death (7.7%) and cases with transfer out, treatment failure or unknown outcome (4.5%). Success rates of all cases and new M+ cases diagnosed were lower than that of reported in BTB during January to June 2010 (Figure 3). Outcome of 22 cases unregistered in BTB during 2010 were loss to follow up (48%), treatment success (29%) and death (14%), which were different from treatment success (84%), death (7%) and loss to follow up (5%) of total 148 reported cases.

Figure 3. Success rate of tuberculosis cases registered in Bureau of Tuberculosis (TB08) and reviewed from 3 hospitals in Satun Province, Thailand, 2010

Usefulness of Surveillance Data

Data from the three systems were used to monitor TB situation and effectiveness of TB control program. The R506 data was used for monitoring trend of incidence, contact tracing and outbreak detection by PHO. Although outbreaks were identified by reviewing each TB cases by PHO, no TB outbreak had been detected up to present. Based on the registered data in BTB, directly observed treatment strategy (DOTS) had been conducted by health volunteers and health centers, and HIV test had been done in 98.2% (163/166) of TB cases registered in 2010 to identify HIV and TB high risk population, which included 34 HIV positive cases. Data of NHSO was used for reimbursement from the hospitals, and conversion rate and success rate in BTB were used to allocate incentive budget from NHSO.

Support for TB Surveillance

Funding and human resources for TB reporting were sufficient for the hospitals and PHO in Satun. There was one staff responsible for R506, and 1-2 staff responsible for BTB and NHSO. A conference to update TB situation and surveillance was conducted annually at regional level, twice a month at provincial level and monthly at district hospitals. However, laboratory personnel were less involved in work plan, and training on data management and adverse effects of treatment were not systematically monitored in the hospitals.

Discussion

Although the three TB reporting systems in Satun Province had different aim and usefulness, all had good capacity to achieve the major objectives of TB surveillance system and their specific objectives, and provided essential information to ensure detection, treatment outcome and monitoring of high-risk population. However, the systems had many reporting forms and complex variables (295 variables in total) which resulted high workload in local level. Coverage and timeliness could be further improved as well. Although the R506 form was simple and easy to use, some hospitals had long lag from diagnosis to reporting in R506 because TB was just one of 84 notifiable diseases in the system and an additional reporting system to a functional BTB system. Moreover, some hospitals had long reporting time and PPV of new M+ was slightly lower than overall PPV since some hospitals also reported new smear negative TB cases. Despite BTB provided more details for monitoring of TB control, it was still complicated. Although NHSO was an online reporting system, it was time consuming for reporting many variables and not easy to access. Completeness of sputum results and treatment outcome in NHSO were lower than it should be due to loss to follow up of some cases and no alert system for data completeness. Although NHSO had the best timeliness of reporting, the data was not used to monitor disease trend or outbreak.

The best method for measuring TB incidence was through a routine surveillance system that captured reliable and comprehensive data on new cases of TB.[4,18] Surveillance systems (TB specific recording and reporting systems and/or general health information systems) should be strengthened until notification was considered to be a direct measure (or

close proxy) of TB incidence.[4,19] In this study, the coverage of TB cases was closed to the CDR which was widely used as an indicator of national progress in TB control since the mid-1990s.[4] CDR for all cases of TB in Thailand during 2009 was 69% which was lower than coverage of all TB cases in BTB and NHSO.[13] In addition, the case notification rates of all types of TB and new M+ in three districts during 2010 were lower than the WHO estimated rates for Thailand of 137 and 66 per 100,000 population.[4] It might be due to the fact that data from WHO was estimated for the whole country, but not just for Satun Province. Another reason was that some TB cases were not detected and caused under-reporting.

In this study, high conversion rate of TB treatment in surveillance data was quite close to the result from the reviewed data, which might imply that appropriate treatments were provided to patients. However, both success rates of all TB cases and new M+ cases were lower than those reported in BTB. Main reason might be over-estimation on treatment outcome of under-reporting cases. However, the success rate reviewed from the hospital data still did not reach the national goal of 90%.[9]

Limitations

Reviewing of all medical records was not completed as some OPD charts could not be found. Foreigner and prisoner cases were excluded in our case definition due to unavailable information, which might underestimate the coverage and PPV of R506. Quality of doctor diagnosis was not assessed in this study, which might over-estimate the performance of surveillance and TB control program. As the TB reporting systems were complicated and included much information, longer study period was needed to verify some unusual data.

Recommendations

In this study, some recommendations were generated for improving TB surveillance and reporting systems at local and central levels. In local health departments, these three systems could be sustained and improved with support and coordination from TB centers, PHO and relevant partners through continuous monitoring and evaluation. More training was needed to improve timeliness of reporting in some hospitals and only new M+ cases should be reported in R506. Laboratory personnel should involve more in work plan and be trained on data management.

In addition, BOE should effectively monitor R506 system, especially on TB case definition for reporting. In BTB system, patients should be registered when they received anti-TB drugs and adverse effects of treatment should be routinely monitored as well. NHSO should share information of different outcomes to all partners. Reporting of registered TB cases in electronic file and integration of R506, BTB and NHSO systems as one national online TB information system should be considered. Because three systems belong to different departments, it was uneasy to integrate them in a short time. However, R506 and BTB could be combined quickly for reporting all new M+ TB cases under coordination by Department of Disease Control in Ministry of Public Health, Thailand.

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