

Analysis of the Tuberculosis Surveillance System at Madani Hospital in Medan Based on Input, Process, and Output Components

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ABSTRACT

Tuberculosis (TB) is a serious public health issue, with Indonesia ranking second in the world in terms of TB cases and North Sumatra Province yet to achieve its optimal case detection target. Hospitals play a crucial role in recording, reporting, and monitoring TB cases. This study aims to analyze the tuberculosis surveillance system at Madani Hospital, Medan, based on input, process, and output components. This study used a descriptive qualitative design, with data collected through interviews, observations, and document reviews. The informants were TB surveillance officers at Madani Hospital, Medan. The results showed that the input and output components generally met minimum standards, but there were still limitations in human resource capacity and supporting facilities for active surveillance. In the process component, TB surveillance has been implemented both actively and passively, but the completeness and timeliness of reporting have not yet reached optimal targets. Overall, the TB surveillance system at Madani Hospital, Medan, has been running quite well, but staff capacity building and reporting quality improvement are needed to support more effective TB control.

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1. INTRODUCTION

Tuberculosis (TB) is one of the leading causes of morbidity and mortality globally. The disease is caused by infection with the pathogenic bacterium *Mycobacterium tuberculosis*. Tuberculosis primarily affects the lungs (pulmonary TB) but can also involve other organs, a condition known as extrapulmonary tuberculosis(1). Globally, tuberculosis remains a major public health problem, with an estimated mortality rate of approximately 13 deaths per hour. Throughout 2020, an estimated 10 million people worldwide developed tuberculosis, resulting in approximately 1.5 million deaths. In the same year, 30 countries accounted for about 86% of new tuberculosis cases globally, with Indonesia ranking third among countries with the highest tuberculosis burden worldwide(2).

Tuberculosis (TB) remains one of the major public health problems worldwide. The World Health Organization (WHO) estimated that in 2023 there were approximately 10.8 million TB cases

globally, with TB continuing to be the leading cause of death from infectious diseases. The high burden of TB cases and mortality indicates that TB control efforts still face significant challenges, particularly in developing countries.

Indonesia is among the countries with the highest TB burden globally. According to the latest Global Tuberculosis Report, Indonesia ranks second after India in terms of the number of TB cases worldwide. It is estimated that more than one million TB cases occur annually in Indonesia, with a substantial number of TB-related deaths. This situation places TB as a national health priority, requiring an integrated and data-driven disease control(3).

At the regional level, TB also remains a serious public health concern. North Sumatra Province, including the city of Medan as a major referral center for health services, continues to experience a gap between the estimated number of TB cases and those successfully detected and reported. This condition indicates the need to strengthen the TB surveillance system to improve case detection, treatment monitoring, and program evaluation in a sustainable manner.

Epidemiological surveillance is a critical component of communicable disease control, including TB. Surveillance serves as a systematic and continuous process of data collection, processing, analysis, and dissemination, which provides the basis for planning, implementation, and evaluation of health programs. In the context of TB, an effective surveillance system supports early case detection, monitoring of disease trends, and evidence-based decision-making (3).

The implementation of TB surveillance can be analyzed using a systems approach consisting of input, process, and output components. Input components include the availability of human resources, financing, infrastructure, as well as guidelines and standard operating procedures. Process components involve data collection, data processing and analysis, and information dissemination. Meanwhile, output components consist of surveillance reports and information used to support policy formulation and health interventions. This approach is widely applied in surveillance system evaluations as it comprehensively describes the interrelationships among system components (4).

Hospitals play a strategic role in the TB surveillance system, particularly as referral health facilities that manage TB cases with higher severity and complexity. In addition to providing curative services, hospitals are responsible for recording and reporting TB cases through the Tuberculosis Information System (SITB) and coordinating with local health offices and networked health facilities. Therefore, the quality of TB surveillance implementation in hospitals significantly affects the overall quality of TB data(5).

Despite the establishment of various national policies and guidelines for TB control, studies evaluating hospital-based TB surveillance systems using an input-process-output approach remain limited. Most TB surveillance studies in Indonesia focus on primary healthcare centers or local health offices. Therefore, more in-depth research at the hospital level is needed to identify strengths and challenges in TB surveillance implementation.

Based on this background, this study aims to evaluate the TB surveillance system at RS Madani Medan using the input, process, and output components. The findings of this study are expected to provide valuable input for hospital management and relevant stakeholders to strengthen hospital-based TB surveillance systems and support the achievement of TB control targets at both regional and national levels.

2. METHOD

This study uses a qualitative approach with a descriptive design. The qualitative descriptive approach aims to describe and interpret the phenomena under study as they are in their natural context. This method is used to systematically examine specific situations or conditions and present the results in the form of a research report (Anggito & Setiawan, 2018; Arikunto, 2013). This research was conducted in a private hospital located in the city of Medan. Informants were selected using purposive sampling, which is the deliberate selection of samples by researchers based on certain considerations relevant to the research objectives, so that the selected informants are able to optimally represent the conditions being studied(6). There was one informant in this study, namely a tuberculosis surveillance officer at Madani Hospital in Medan who has been in office since 2021. The tuberculosis program officer has a role in recording cases, reporting through the Tuberculosis

Information System (SITB), coordinating with the Medan City Health Office, and being responsible for all tuberculosis control and prevention activities at the hospital. The inclusion criteria for selecting informants were officers responsible for tuberculosis recording and reporting activities, while the exclusion criteria included officers who were unwilling to become research informants. The data used were primary data collected through in-depth interviews and observation. Data collection focused on the input components (man, material, method, money, and market), the process (data collection, data analysis and interpretation, and information dissemination), and the output in the form of tuberculosis surveillance information.

3. RESULTS AND DISCUSSION

The results of interviews with informants were summarized based on three indicators, namely input, process, and output. The interview results were also compared with ideal conditions based on applicable guidelines (Table 1).

Table 1. Indicator Tuberculosis Surveillance System

Indicator	Existing Conditions	Ideal Conditions
Input		
a. Man	- Number of TB case investigators = 2 - TB program officer training consists of SITB training and contact investigation.	- Number of TB cases ≥ 2 - TB program officer training consists of SITB training, contact investigation, clinical understanding training, and PPI training.
b. Money	- Funding sources: Regional Public Hospital, Regional Budget, and NGOs - Advocacy is conducted regularly to the Health Office.	- Funding sources: Regional General Hospital Business Entity (BLUD RS), Regional Budget (APBD)/State Budget (APBN), NGOs, BPJS, Grants - Advocacy is conducted regularly to the Health Office.
c. Material	- Equipment used: computers, internet, office supplies, SITB, and TCM tools, microscopes, radiology equipment, standard recording forms, and PPE.	- Equipment used: computers, internet, office supplies, SITB, and TCM tools, microscopes, radiology equipment, standard recording forms, and PPE
d. Method	- The input method follows the 2023 national TB guidelines, technical instructions, and internal hospital SOPs, etc.	- The input method follows the 2023 national TB guidelines, technical instructions, and internal hospital SOPs, etc.
e. Market	- Information dissemination targets: hospital management, local health offices, networked community health centers, internal service units, the public	- Information dissemination targets: hospital management, health offices, networked community health centers, internal service units, the public
Process		
a. Data Collection	- Methods used: passive & active surveillance - Achievement of data collection process indicators: completeness of reports by reporting units 85%, timeliness of reporting by reporting units 80%, feedback 100% - Media used to send reports: SIBT	- Methods used: passive & active surveillance - Achievement of data collection process indicators: 100% completeness of reports by reporting units, 100% timeliness of reporting by reporting units, 100% feedback - Media used to send reports: SIBT, SIMRS, TB.01 Form, TB.03 Form
b. Data Analysis and Interpretation	- Analysis of gender, time, and place was conducted using	- Analysis of people, time, and place was conducted using descriptive epidemiological

	descriptive analysis	epidemiological analysis	analysis, frequency analysis, and proportion analysis.
	- The results of data interpretation were presented in infographics (tables, graphs, maps) according to the variables of gender, place, and time	- The results of data interpretation were presented in infographics (tables, graphs, maps) according to the variables of gender, place, and time.	- The results of data interpretation were presented in infographics (tables, graphs, maps) according to the variables of gender, place, and time.
c. Information Dissemination	- Dissemination is carried out through: monthly, quarterly, and annual reports, as well as regular network meetings	- Dissemination is carried out through: monthly, quarterly, and annual reports, as well as regular network meetings.	- Dissemination is carried out through: monthly, quarterly, and annual reports, as well as regular network meetings.
	- Dissemination activities involve internal hospital cross-program parties, cross-sectors, policy makers, and patients	- Dissemination activities involve internal hospital cross-program parties, cross-sectors, policy makers, patients, and the general public.	- Dissemination activities involve internal hospital cross-program parties, cross-sectors, policy makers, patients, and the general public.
Output			
a. Information	- Surveillance output generates monthly, quarterly, and annual SITB reports and hospital profile data.	- Surveillance output generates monthly, quarterly, and annual SITB reports and hospital profile data.	- Surveillance output generates monthly, quarterly, and annual SITB reports and hospital profile data.

Overall, a comparison between the existing conditions at Madani Hospital in Medan and the ideal conditions shows that there is a not-too-significant gap in several crucial components of the TB surveillance system. On the input side, the most notable gaps are in human resource limitations and the lack of special transportation facilities to support active surveillance. In the Process component, the methods used already include active and passive surveillance, although the indicators of timeliness and completeness of reporting have not yet reached the ideal target of 100%. However, the Method (guidelines) and Market (dissemination targets) aspects are relatively in line with the established standards.

This discussion elaborates the study findings by relating them to the implementation of tuberculosis surveillance at Madani Hospital, Medan, and relevant evidence from previous studies.

3.1 Input Components

The input components of tuberculosis surveillance include human resources, funding, facilities and infrastructure, methods, and information dissemination targets, which collectively determine the readiness and effectiveness of surveillance implementation.

3.1.1 Man (Human Resources)

The results of the study show that two Wasor TB individuals quantitatively meet the minimum standards. However, there are still qualitative competency deficiencies, especially in terms of the types of training received by officers. Training in clinical understanding of TB and Infection Prevention and Control (IPC) is not yet fully available, and the training that has been undertaken is still limited to SITB training and contact investigation.

The overall quality of the TB surveillance system can be affected by this situation. Surveillance officers not only record data but also act as initial analysts who must understand the diagnosis process, case classification, and the possible spread of tuberculosis in health facilities. A study conducted by Siregar and Lubis (2021) found that a lack of clinical and IPC training can lead to inaccurate TB case classification and delays in reporting confirmed cases. Hidayat et al. (2023) also reached similar findings. They concluded that the success of TB surveillance in health care facilities is greatly influenced by the competence of human resources(7). Limited human resources also affect the implementation of active surveillance, especially in contact investigations and tracing of defaulting cases. The situation is exacerbated by the unavailability of special transportation to support field surveillance activities, which hinders active case finding efforts.

3.1.2 Money

Funding for TB surveillance at Madani Hospital in Medan comes from the hospital's BLUD, the regional budget (APBD), and NGOs, and is supported by regular advocacy to the Health Office. This demonstrates institutional commitment to supporting TB surveillance. However, funding sources are still not fully diversified because the state budget (APBN), BPJS, and grant schemes are not yet being used optimally(8). According to Putri et al. (2022), the lack of funding sources directly hinders active surveillance activities, particularly in terms of financing for field supervision, human resource capacity building, and transportation. Therefore, although the current funding sources are sufficient to carry out routine surveillance, the sustainability and expansion of surveillance activities still require cross-sectoral funding support.

3.1.3 Materials (Facilities and Infrastructure)

The results of the study indicate that the material and procedural components are in line with ideal standards. At Madani Hospital in Medan, the TB surveillance system relies on the availability of facilities such as the SITB application, TB diagnostic tools (TCM, microscopes, and radiology), and standard recording forms. In addition, the implementation of monitoring has been within the appropriate regulatory framework, as indicated by the 2023 National TB Guidelines and internal SOPs. Available facilities include computers, internet networks, office stationery, access to the Tuberculosis Information System (SITB), and Molecular Rapid Test (TCM) kits. The availability of these facilities indicates that, in general, the implementation of TB surveillance at Madani Hospital in Medan is in accordance with the Guidelines for the Implementation of the Health Epidemiological Surveillance System as stipulated in the Decree of the Minister of Health of the Republic of Indonesia Number 1116 of 2003.

The availability of Molecular Rapid Test (MRT) equipment is an important component in supporting the TB surveillance system, considering that MRT is a diagnostic tool used to detect the presence of *Mycobacterium tuberculosis* bacteria in patient sputum. The use of TCM is a priority in TB testing because it has high sensitivity, relatively fast testing time, and the ability to simultaneously detect Drug-Resistant Tuberculosis (DR-TB)(5). Thus, the availability of TCM at Madani Hospital in Medan contributes positively to the implementation of TB surveillance. Limited transportation facilities have the potential to hamper active surveillance activities, such as case tracing and field coordination.

In addition, technical obstacles were also found in the use of the Tuberculosis Information System (SITB), particularly in relation to the speed of access to the application, which sometimes experienced slowdowns. The slow access to SITB was caused by the high number of health workers in Indonesia accessing the system simultaneously, which hampered the process of recording and reporting TB cases. This problem is a systemic obstacle originating from the SITB system itself. Therefore, TB officers at health care facilities are advised to provide feedback to provincial and central authorities regarding the technical obstacles encountered, so that this can serve as a basis for the development and improvement of the system by the central government and relevant authorities.

3.1.4 Method

The implementation of tuberculosis surveillance at Madani Hospital in Medan has been based on the 2023 National Guidelines for Tuberculosis Control and supported by the hospital's internal standard operating procedures (SOPs). These guidelines serve as the main reference for officers in carrying out systematic and standardized TB surveillance activities, from case detection and recording to reporting.

The guidelines used have comprehensively covered tuberculosis management, including aspects of detection, prevention, and case management, and have been compiled based on various TB classifications, such as TB with diabetes mellitus comorbidity, drug-sensitive TB, drug-resistant TB, TB with HIV, TB in children, and latent tuberculosis. The completeness of these guidelines supports the uniform implementation of TB control in accordance with the characteristics of cases found in health care facilities(9).

In addition, the implementation of TB surveillance has also been aligned with applicable national regulations, including Minister of Health Regulation No. 67 of 2016 concerning Tuberculosis Control and the 2020 Minister of Health Decree concerning the National Guidelines

for Medical Services for Tuberculosis Management and the National Formulary. This is in line with the research by Rahmawati et al. (2023), which states that methods and tools must comply with national guidelines for accurate and accountable TB surveillance(10).

3.1.5 Market

The results of the study show that from the perspective of information dissemination targets, surveillance information has been distributed to hospital management, the Health Office, networked community health centers, internal units, and the community. However, active community involvement needs to be increased so that surveillance data is not only administrative but also serves as a tool to promote and prevent tuberculosis.

The target audience for surveillance information dissemination, often referred to as the market, refers to parties who need and utilize surveillance information as a basis for decision-making in disease control. The surveillance information produced needs to be conveyed to relevant stakeholders so that it can be optimally used in the planning, implementation, and evaluation of health programs(7).

Information dissemination is carried out through regular coordination, both formally through network meetings and informally through communication media such as WhatsApp groups. These targets include parties directly involved in TB control efforts, particularly in the areas of case detection, treatment, and prevention of TB-related deaths.

With the fulfillment of TB surveillance information needs for the right targets, stakeholders are expected to understand the actual conditions in the field and provide appropriate input and feedback on program implementation. This information is an important basis for TB program managers in determining appropriate interventions that are in line with the epidemiological situation and existing risk factors, thereby supporting the improvement of TB control effectiveness(7).

3.2 Process Components

In the tuberculosis surveillance system, the process component plays a critical role in translating available inputs into usable information for program decision-making. This component encompasses a series of interrelated activities, including data collection, data processing, analysis, reporting, and feedback mechanisms. Effective implementation of these processes is essential to ensure that surveillance information is timely, complete, and accurate, thereby supporting evidence-based interventions in tuberculosis control.

3.2.1 Data Collection

Madani Hospital in Medan identified all TB cases through data collection via active and passive surveillance. The completeness rate of reports from internal reporting units reached approximately 85%. Most service units have recorded and reported TB cases through the Tuberculosis Information System (SITB). However, there are still incomplete reports, mainly due to the high workload in service units. This condition is in line with research findings in Indonesia which state that clinical service workload is one of the factors that affect the quality and completeness of TB surveillance data in referral health facilities (Simarmata et al., 2020).

The accuracy of TB case reporting at Madani Hospital in Medan is reported to be around $\pm 80\%$. Delays in reporting generally occur due to internal data flows that are not always timely, as well as technical constraints in the SITB application, which sometimes experiences slowdowns or system disruptions. Similar problems have also been reported in the implementation of national TB surveillance, where the optimization of health information systems remains a challenge in ensuring the timeliness of case recording and reporting (Indonesian Ministry of Health, 2016; Indonesian Ministry of Health, 2019)(7). The 80% timeliness rate also indicates that the reporting process still faces several obstacles. According to Putri et al. (2022), many factors contribute to delays and incompleteness in SITB reporting. One of them is the high workload of officers, limited human resources, and suboptimal integration between SITB and the hospital information system (SIMRS). The results of this study are relevant because the reporting media used are still limited to SITB and are not yet fully integrated with manual forms and SIMRS.

Meanwhile, feedback on TB reports from within the hospital to the reporting unit has been optimally implemented with a 100% achievement rate. Every report that comes in is always followed up through direct coordination, communication via online media such as WhatsApp groups, as well as discussions in internal meetings and networks. A well-functioning feedback mechanism plays an important role in improving reporting compliance, improving data quality, and supporting more accurate decision-making in tuberculosis control at the hospital level.

3.2.2 Data Analysis and Interpretation

Data analysis and interpretation in hospitals is conducted based on variables of people, time, and place, using a descriptive epidemiological approach to analyze the data. This method is in line with TB surveillance data analysis standards and allows for the identification of case distribution patterns in a simple yet informative manner. It is very useful to present the analysis results in the form of tables, graphs, and maps as this makes it easier for stakeholders to understand TB incidence trends. According to research by Rahmawati et al. (2023)(10), surveillance data visualization is very important to assist evidence-based decision making, especially in determining intervention priorities. Conversely, data analysis is still limited to descriptive analysis and has not yet developed to support long-term strategic planning. This is because human resources are still limited to conducting in-depth analysis.

3.2.3 Dissemination of Information

Although TB surveillance information has been routinely disseminated through monthly, quarterly, and annual reports, as well as cross-program and cross-sector network meetings, public involvement remains limited. According to Nuraini and Hidayat (2024)(11), disseminating surveillance data to the public is crucial for increasing awareness, treatment adherence, and community participation in TB prevention. Therefore, more inclusive dissemination strategies should be used, such as through health promotion and community-based education media.

3.3 Output Components - Information

Monthly, quarterly, and annual SITB reports and hospital profiles have been regularly produced as a result of tuberculosis monitoring. This shows that the TB surveillance system at Madani Hospital in Medan is capable of producing the necessary epidemiological information. However, Wardani et al. (2020) state that the quality of surveillance is not only measured by the availability of reports, but also by how well the information is collected and analyzed(12).

4. CONCLUSION

The tuberculosis surveillance system at Madani Hospital in Medan has generally been running quite well and has covered the input, process, and output components in accordance with national guidelines. The availability of human resources, funding, infrastructure, as well as guidelines and standard operating procedures has supported the implementation of TB surveillance in hospitals. The surveillance process has been carried out through active and passive surveillance, accompanied by descriptive data analysis and dissemination of information through routine reports and networking activities. Surveillance outputs in the form of SITB reports and hospital profile data have been produced periodically. However, there are still several obstacles, particularly in terms of limited human resource capacity, variations in staff training, and constraints in the completeness and timeliness of reporting. To overcome these problems, Madani Hospital in Medan is advised to strengthen its human resources by adding personnel and providing regular training accompanied by clinical understanding and PPI training, clarifying internal reporting procedures, and optimizing data quality monitoring and coordination related to SITB constraints with the relevant central authorities. These efforts are expected to improve the completeness and timeliness of reporting and strengthen the role of hospital-based TB surveillance.

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