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Email : editorijhess@gmail.com

Analysis Of Risk Factors For TB Transmission In Healthcare Workers And Optimization Strategies For TB Transmission Prevention At Bun Hospital

Yuly Periostiowati[1)], Khairulyati[2)]
[1,2)] Master of Public Health, Universitas Strada Indonesia

*Corresponding Author
Email : irulcatalina@gmail.com

Abstract

Prevention and control of Tuberculosis (TB) in healthcare facilities is crucial due to the high risk of transmission among healthcare workers. At BUN Hospital, six nurses were confirmed with TB during the 2025 annual screening, despite the implementation of the four pillars of TB IPC. This community service activity aims to analyze risk factors for TB transmission among healthcare workers and to formulate strategies for optimizing TB transmission prevention. The method used was a stepwise analysis: a fishbone diagram to map root causes, USG analysis to determine problem priorities, and SWOT analysis to formulate strategies. The analysis results were presented through interactive dissemination to management, the IPC Team, Quality Team, doctors, and nurses. The study identified inadequate socialization of TB SOPs and a weak monitoring system as the main risk factors causing suboptimal compliance with PPE use. Two priority strategies were agreed upon: a) periodic socialization and retraining on TB IPC SOPs; b) strengthening the monitoring system for SOP implementation. This activity results in management commitment to follow up on these strategies. It was concluded that optimizing SOP socialization and strengthening the monitoring system for SOP implementation, supported by management commitment, can serve as a strategy for preventing TB transmission among healthcare workers at BUN Hospital.

Keywords: ***Tuberculosis, Healthcare Workers, Sop, Supervision, Infection Control.***

INTRODUCTION

Tuberculosis (TB) remains one of the leading causes of death worldwide and is among the top 10 causes of death according to the WHO. For healthcare workers, TB poses a real threat, especially to those who interact directly with TB patients on a daily basis (Daradkeh et al., 2025). Of the approximately one-third of the global population infected with TB, healthcare workers are at the highest risk of transmission (Zwerling et al., 2012). Various studies also show that healthcare workers are more susceptible to developing TB, both latent and active, than the general population (Nienhaus et al., 2014).

TB transmission occurs when someone inhales aerosols released when an infected person coughs, talks, or sneezes. These germ particles can linger in the air for quite some time, depending on how well the room is ventilated and whether there is direct sunlight exposure (Alsayed & Gunosewoyo, 2023). Often, cases of TB transmission in healthcare workers are only detected late. This is because early respiratory symptoms are often subtle and delayed, making early detection difficult (Ngo et al., 2019). Therefore, the success of TB prevention in

Hospitals cannot be separated from the role of management, ongoing education for staff, and compliance with proper PPE use (Meregildo-Rodriguez, 2023). When PPE, such as particulate masks, is used correctly and consistently, the risk of staff contracting TB can be significantly reduced (Jh et al., 2020). However, the reality on the ground is not always ideal. A study in Nepal, for example, found that many nurses still lack knowledge and poor preventive practices, even failing to use N95 masks when caring for TB patients (Baral & Koirala, 2022).

This high risk for healthcare workers aligns with findings at BUN Hospital. Although the hospital has committed to implementing TB control through managerial, administrative, environmental, and personal protective equipment (PPE) measures, employee screening in 2026 still found six nurses confirmed with TB. This situation reinforces evidence that without consistent implementation, healthcare workers remain the most vulnerable group, as reported by previous

research. Therefore, risk analysis and optimization strategies for preventing TB transmission among staff at BUN Hospital are crucial as a form of community service.

The purpose of this Community Service activity is to analyze the risk factors that contribute to TB transmission among healthcare workers at BUN Hospital and develop effective prevention strategies, thereby creating a safer environment for healthcare workers and improving the quality of patient care. By identifying and addressing the root causes of TB transmission, BUN Hospital can reduce the risk of infection among its staff and provide a healthier environment for patients and visitors.

RESEARCH METHODS

In analyzing cases of TB transmission among BUN Hospital staff, the authors referred to the risk factors listed in the WHO TB Control and Prevention Program and compared them with the actual implementation conditions at BUN Hospital. To determine which problems most needed to be addressed first, the authors applied the concept of prioritizing problems using a fishbone diagram. In the field of quality management, a fishbone diagram is also known as a cause-and-effect diagram. This method was first developed by Kaoru Ishikawa, a figure dubbed the father of Japanese quality for his contributions to quality control techniques. The main function of this diagram is to help the team conduct a Root Cause Analysis (RCA) of a problem, so that from mapping the causes, concrete improvement ideas can emerge (Chen., 2024). In this diagram, the "head of the fish," usually located on the right side, depicts the main problem or area to be addressed. Each "bone" branching from the spine represents a large group of causal factors. The team then explores various possible causes and sub-causes by repeatedly asking "why" the problem occurred. This group of causes generally includes work methods or systems, machinery and equipment, human resources, materials, the environment, and measurement aspects. This category is flexible and can be adapted to the context of the problem. Through a fishbone diagram, stakeholders can map which factors contribute significantly and which contribute less significantly to the problem. This comprehensive list of causes serves as the basis for the team to collaboratively design targeted process improvement steps. The final results of this analysis can be used by management as a reference in establishing service quality improvement policies.

The USG method is used to prioritize when resources, time, and manpower are limited, preventing an organization from addressing all issues simultaneously (Nurcahyo et al., 2023). The assessment is conducted by assigning a score of 1–5 to three aspects. Urgency assesses how urgently a problem must be resolved based on available time. Seriousness measures the severity of the impact if left untreated. Growth assesses how quickly a problem could develop and trigger new problems (S. Ariyanti, 2020). At BUN Hospital, all risk factors resulting from the fishbone analysis are assessed using these three criteria. The factor with the highest total score is designated as the top priority for follow-up. This method ensures that interventions are focused on the most pressing, impactful, and potentially widespread issues if not addressed promptly.

Table 1. Scoring Description Table

Skor	Keterangan
5	Sangat Penting
4	Penting
3	Netral
2	Tidak Penting
1	Sangat Tidak Penting

A SWOT analysis is a method for evaluating the strengths, weaknesses, opportunities, and threats within an organization, plan, project, program, individual, or business activity. SWOT is a commonly used strategic planning tool for assessing internal and external factors within an organization. This framework is effective for planning and managing resources to achieve specific

goals within a specific timeframe (Sharath Kumar CR, 2023). This analysis consists of four components divided into two dimensions: internal factors in the form of strengths and weaknesses, and external factors in the form of opportunities and threats. By analyzing these four components, SWOT can be used to formulate business strategies based on the organization's internal and external conditions.

RESULTS AND DISCUSSION

This report uses a fishbone analysis with an approach of man, material, method, machine, and environment. Findings from interviews, discussions, and environmental observations are recorded as "fishbone" branches to identify the root of the problem. Based on this mapping, alternative ideas for solving the problem are then compiled and priorities are determined using ultrasound analysis. The assessment of the problem of TB transmission among healthcare workers at BUN Hospital is categorized using: man, material, method, machine, and environment. The explanation is as follows: Man, compliance with the use of PPE according to SOP is not optimal and high turnover of healthcare workers. Material, Particulate masks PPE is inadequate for non-nurses. Method, SOP related to PPI TB is not well socialized and monitoring of compliance with the use of Particulate masks PPE is not optimal. Machine, not all rooms are available with temperature and humidity measuring devices. Environment, isolation rooms are not always closed according to SOP.

Based on the fishbone diagram, the risk factors causing Mycobacterium tuberculosis infection in 6 nurses at BUN Hospital include suboptimal compliance with the use of PPE according to SOPs, high turnover rates of health workers, unavailability of adequate particulate masks for non-nursing staff, TB PPI SOPs that have not been properly socialized, not all rooms are equipped with temperature and humidity measuring devices, isolation rooms that are not always closed according to SOPs, and suboptimal monitoring of compliance with the use of Particulate Mask PPE.

Table 2. Problem Priority Determination Table

No	Masalah	U	S	G	Jumlah	Prioritas
1.	Kepatuhan penggunaan APD sesuai SPO tidak optimal	5	4	4	13	II
2.	Tingginya turn over tenaga kesehatan	5	4	3	12	III
3	APD Masker Partikulat yang tidak memadai untuk non perawat	5	5	3	13	II
4	Tidak tersosialisasi SPO terkait PPI TB dengan baik	5	5	4	14	I
5.	Tidak tersedianya alat ukur suhu dan kelembaban pada semua ruangan	3	3	3	9	IV
6	Ruang isolasi tidak selalu tertutup sesuai SPO	5	5	3	13	II
7	Monitoring kepatuhan penggunaan APD maske partikulat belum optimal	5	4	4	13	II

Based on Table 2, the results of the USG analysis indicate that the root cause of TB transmission at BUN Hospital is dominated by method and human factors, namely the suboptimal socialization of SOPs and weak compliance and supervision of PPE. Material and environmental factors such as the availability of masks and the condition of isolation rooms are also pressing, but all stem from the lack of internalization of TB PPI procedures. Therefore, priority interventions should be directed at strengthening the socialization of SOPs systematically followed by improving the compliance monitoring system, as these two factors have the greatest potential to reduce the risk of transmission.

After identifying the main problems using the ultrasound method, the next step is to develop a problem-solving strategy using a SWOT analysis. A SWOT analysis involves identifying the hospital's strengths, weaknesses, opportunities, and threats. By understanding these aspects, effective

strategies can be determined to address the identified problems. The results of the SWOT analysis at BUN Hospital are as follows:

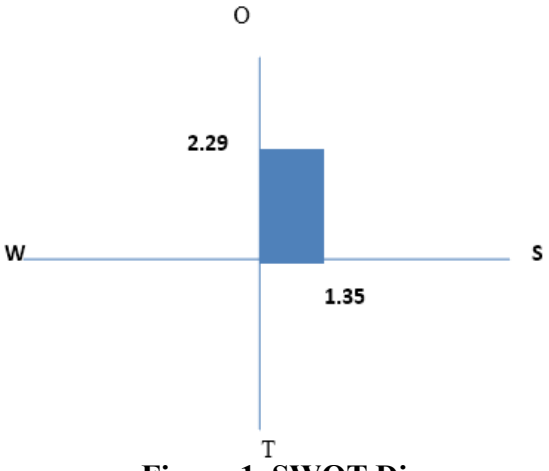

Figure 1. SWOT Diagram

Based on the results of the SWOT analysis, the SO strategy in quadrant I-aggressive that can be implemented includes utilizing management commitment and the existence of the established PPI Team to conduct massive and regular re-socialization of the TB PPI SOP to all units, including non-nursing staff, by optimizing internal resources such as educational media and existing in-house training schedules. In addition, support from hospital policies and the PPI budget can be used to strengthen the PPE compliance monitoring system through the preparation of daily checklists and the appointment of role models in each room.

Based on the proposed strategy above, from the results of the fishbone, USG, and SWOT analysis, the strategy that can be implemented in this residency activity as well as community service is the re-socialization of the SOP PPI TBC in a structured manner to all officers and strengthening the monitoring of compliance with the PPE particulate masks through the implementation of a daily checklist carried out together with the existing unit managers, in an effort to increase compliance with the PPI TBC procedures and reduce the risk of Mycobacterium tuberculosis transmission to health workers at BUN Hospital.

This community service activity concluded with the dissemination of the analysis results and discussions. This activity aimed to convey the findings and analysis of the factors causing TB transmission as well as strategies for optimizing TB transmission control and prevention. Participants in the dissemination consisted of structural officials at BUN Hospital, the Head of the Quality Team, the Head of the PPI Team, representatives of general practitioners, and representatives of nurses. The dissemination method was carried out interactively through presentations and discussions to ensure shared understanding while obtaining validation, input, and commitment to the improvement plan. The discussion focused on verifying the suitability of the analysis findings with field conditions, identifying obstacles to strategy implementation, and agreeing on optimization strategies. The discussion resulted in an agreement between management and the PPI Team in determining alternative problem-solving strategies, namely: a) Dissemination and retraining of SOPs related to TB PPI; b) Strengthening the monitoring system for the implementation of SOPs related to TB PPI. The commitment built from this activity serves as an important basis for ensuring the sustainability of the implementation of TB transmission prevention strategies within the BUN Hospital environment.

Figure 2. Interview with Nurse

Figure 3. Presentation of Socialization of Results

CONCLUSION

Based on the analysis, it can be concluded that TB transmission remains a serious threat in healthcare environments, especially for healthcare workers. The SWOT analysis results indicate that reducing the risk of TB transmission in hospitals can be achieved through increased socialization and regular training of TB SOPs, provision of adequate and high-quality PPE, strengthening supervision and evaluation of compliance with PPE use, and strengthening cooperation between healthcare workers, management, and other relevant parties. It is concluded that optimizing SOP socialization and improving the PPE compliance monitoring system, supported by management commitment, is a strategy for preventing TB transmission among healthcare workers. Therefore, it is recommended that hospitals implement this strategy continuously with regular monitoring to ensure the effectiveness of preventing TB transmission in healthcare environments.

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