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Ishikawa Diagram is Used to Map and Overcome Factors that Contribute to a Problem

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Abstract

Tuberculosis (TB) is an infectious disease that ranks second as the second highest cause of death. Despite ongoing control efforts, contact investigation coverage in various regions is still relatively low, including in Pekanbaru City, which only reaches 8% of the national target. Contact investigation is a key step in breaking the chain of TB transmission, but its implementation faces various obstacles. This study aims to identify the root causes of the low TB contact investigation coverage in Pekanbaru using the Ishikawa Diagram. Through in-depth interviews and qualitative analysis, five main categories of causes were found, namely: (1) environment, in the form of a lack of

cross-program advocacy; (2) machines, namely network constraints in online reporting; (3) costs, in the form of minimal budget allocation; (4) methods, including unsustainable supervision and suboptimal recording; and (5) people, namely limited human resources. The results of this study indicate that the Ishikawa Diagram approach is effective in systematically mapping and analyzing problems. These findings can be the basis for formulating more appropriate strategies to increase the scope of TB contact investigations to reduce transmission rates in the community.

Keywords: Tuberculosis, Contact Investigation, Ishikawa Diagram, Transmission, Root Cause

Introduction

World Health Organization (WHO) in 2022 stated that tuberculosis (TB) was the second most common cause of death in the world due to a single infectious agent and caused almost twice as many deaths compared to other diseases [1]. In 2020, 30 countries with a high TB burden accounted for 86% of new TB cases. Two-thirds of this number came from eight countries, with India being the largest contributor, followed by China, Indonesia, the Philippines, Pakistan, Nigeria, Bangladesh, and South Africa [2]. In general, tuberculosis (TB) infections occur more frequently in vulnerable population groups, such as malnourished children [3] and attacks individuals with weak immune systems, especially those infected with HIV (Human Immunodeficiency Virus) [4].

The combined prevalence of TB in southern countries, nationalities and communities was 0.2% which is slightly higher than the combined prevalence of TB in Ethiopia (0.19%) in the same year [5]. WHO estimates that 10.6 million people developed active tuberculosis (TB) in 2021. After years of declining TB mortality rates, TB-related deaths increased to 1.6 million in 2021 [6]. Approximately 3.5 to 10% of people who come into contact with a TB patient may develop an active infection, while about a third may be infected without showing symptoms or developing the disease. Those at high risk of infection are individuals who have close contact with TB patients, such as children, the elderly, and people with weakened immune systems, for example due to malnutrition or HIV infection. Of those infected, approximately 5 to 10% have a chance of developing active tuberculosis [7].

In a South African screening study of 259 contacts, nearly half (47.1%) underwent TB clinical investigation, with 17 (6.6%) new TB cases diagnosed, representing a prevalence rate of 6564 per 100,000 population. Fifteen contacts need to be screened to detect one new TB case [8]. Research conducted at the Ciwandan Community Health Center in Cilegon City found that the implementation of Contact Investigation and Tuberculosis Preventive Therapy was going well. However, there were obstacles, particularly in providing Tuberculosis Preventive Therapy to household contacts. Support from health workers, cadres, and

leaders was crucial to the program's success. The program's implementation has shown a reduction in TB transmission rates and accelerated patient recovery times, although further efforts are needed to address challenges in the field [9]. The surveillance system in Riau Province has not been running optimally. According to a report from the Indonesian Ministry of Health Sub-Directorate, the percentage of Case Indexes for which Contact Investigations were conducted in Riau Province in 2022 only reached 39% [10].

The primary reason for writing this article is the imbalance between the large TB burden and the low coverage of case tracing, which should be a key pillar in prevention efforts and breaking the chain of transmission, due to the low number of contact investigations conducted. Analyzing the low coverage of contact investigations can reveal the factors influencing the program's success and recommendations that can be used to increase the scope of contact investigations to reduce TB transmission rates. The Ishikawa diagram is an effective method for identifying, evaluating, and addressing a problem by mapping the various causal factors that contribute to the occurrence of a particular problem or impact.

Method

An Ishikawa diagram is typically constructed by placing the main problem to be analyzed at the front of the diagram. Then, the main contributing factors are identified, leading to

branches that radiate from the main line of the diagram. The final shape of this diagram resembles the skeleton of a fish, hence the name "Fishbone Diagram." In the second stage, the main factors influencing the problem are classified into subcategories, which are depicted as smaller branches extending from the main bone [11]. Therefore, the Ishikawa diagram can be used to systematically and in-depthly compile the process of identifying and analyzing the causes of a problem [12, 13]. Over time, the Ishikawa diagram has been used in various other disciplines to illustrate complex relationships with multiple causes. The application of this method in various research fields reflects the flexibility and broad potential of the Ishikawa diagram [12, 14-17].

As a further illustration, the achievement of TB contact investigations in Pekanbaru City, which is 8% of the National Target, is shown at the head of the Ishikawa diagram (Fig 1). When analyzing the root causes of the main problem, researchers conducted in-depth interviews by recording all interview activities. The interview results were systematically analyzed to identify the causes related to the main problem. These causal factors were then arranged into a fishbone-shaped Ishikawa diagram (Fig 1). The Ishikawa diagram does not limit the number of fishbones that can appear. The fishbone diagram allows each section to be broken down into smaller branches so that the relationship between potential causes and the problem can be seen more clearly.

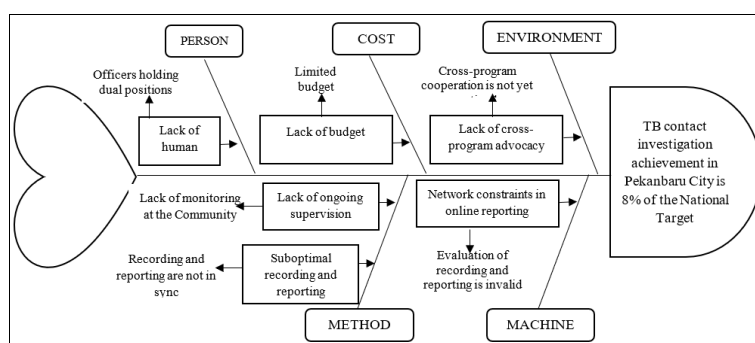


Fig 1: Ishikawa diagram

Results and Discussion

The factors causing the achievement of TB contact investigations in Pekanbaru City to be 8% of the national target have been identified and classified into five categories related to environment, machines, costs, methods and people.

1. Environment: Environmental factors that are the cause are the lack of cross-program advocacy

Lack of cross-program advocacy is also a contributing factor to the low reach of contact investigations in tuberculosis (TB) patients. This lack of cross-program advocacy causes TB programs, particularly contact investigations, to operate in isolation without support. This hampers contact tracing coverage, especially in communities. To improve outcomes, a robust advocacy strategy is needed, targeting stakeholders at various levels and sectors.

Research conducted at the Tegal Timur Community Health Center in Tegal City concluded that environmental conditions were supportive in the discovery of pulmonary TB cases with optimal communication relationships within the organization, but indirect outreach methods were not yet

optimal [18]. This answers the research conducted by researchers.

2. Machine: The machine factor that causes this is network constraints in online reporting

The Tuberculosis (TB) program currently relies on digital reporting, primarily through the Tuberculosis Information System (SITB), which is used to record TB patient data and contact investigation results. However, this system relies heavily on stable internet access and supporting devices. Network constraints in online reporting, particularly in the SITB system, significantly contribute to the low achievement of TB contact investigations. This issue is technical in nature but has administrative implications, requiring serious attention in terms of digital infrastructure, training, and an adaptive reporting system.

Research conducted at the Tambusai Community Health Center, Rokan Hulu Regency through in-depth interviews and direct observation related to recording and reporting of monitoring and evaluation found that the problem was poor

internet network in recording and reporting TB at the Community Health Center ^[19].

3. Costs: The identified cause of costs is a lack of budget

TB contact investigation is a crucial activity in efforts to break the chain of TB transmission. This activity involves home visits, tracing and examining household contacts, and recording and reporting data. All of this requires an adequate budget, covering operational costs, transportation, equipment, and human resources. A lack of budget directly hampers the implementation of TB contact investigations by impacting logistics, transportation, incentives, equipment, and the quality of implementation. Without adequate funding, contact investigation outcomes will remain low, and TB transmission will be difficult to control.

This is in accordance with research conducted in Depok City where the availability of TB program funds is still limited, so optimal funding is needed to reduce TB problems in Depok City and eliminate TB by 2030. To overcome limited funds, good financial management is needed so that funding can be prioritized for the TB program ^[20]. In line with research conducted in Enugu State, Southeastern Nigeria, at the state level, allocated funds were not channeled to TB programs. At the local government level, unlike other public health programs, TB control programs do not have a budget ^[21].

In contrast to research conducted in Rokan Hulu through in-depth interviews and direct observation, it was found that funding in the TB program and funds for the treatment of TB sufferers did not encounter funding obstacles faced in the TB program and the management of funds in the TB program ^[19].

4. Method. The method obtained as the cause is:

4.1 Lack of ongoing supervision

Ongoing supervision is the process of routinely coaching, monitoring, and mentoring the implementation of TB contact investigation activities by authorized parties, such as district/city TB program managers, the Health Office, or community health center supervisors. Without regular and high-quality supervision, TB contact investigation activities will not run optimally. Many obstacles go undetected, staff motivation decreases, and reporting is inaccurate. As a result, contact investigation outcomes are low, and TB transmission in the community remains high.

Research conducted at the Sikumana Health Center in Kupang City answers this research, namely monitoring and evaluation activities are carried out twice a year by the Health Office by coming directly to the health center and sometimes monitoring and evaluation are only carried out via Whatsapp group by the head of the health center carried out every month by the program manager sending monthly reports, there are also mini-workshops for evaluation by presenting the program scope and identifying problems by the program manager and the audit team conducting audits based on existing SOPs, whether the program being run is in accordance with the SOP or not ^[22].

4.2 Suboptimal recording and reporting

Suboptimal recording and reporting means that data collected is inaccurate, incomplete, late, or substandard. This significantly impacts the success of TB contact investigations. TB recording systems (e.g., TB Identification Centers) may not be connected to laboratory or community

health center systems, leading to discrepancies between the number of contacts tested and those reported.

Similar research indicates that the implementation of the TB Surveillance System (SITB) requires significant improvements to make recording, reporting, and tracking more efficient and accurate. Furthermore, integration of information systems within healthcare facilities is crucial to support the tuberculosis surveillance reporting system in Indonesia ^[23]. Another study concerning reporting was also conducted in Mpumalanga Province, South Africa, where accurate reporting of TB treatment outcomes, especially cure rates, is crucial to understanding the rise in MDR-TB that may be associated with treatment failure or high default rates, as well as assisting national programs in optimizing strategies to improve TB control ^[24].

5. People: A potential cause identified from the people category is a lack of Human Resources

Lack of human resources (HR) is a major factor in the low reach of contact investigations in tuberculosis (TB) patients. Contact investigations require personnel to conduct contact tracing, home visits, interviews, and examinations of household or close contacts of TB patients. If the number of personnel is insufficient, not all TB patients will receive optimal contact investigations.

A case study conducted in Pakistan revealed that one of the major shortcomings in the TB control program was the lack of an active contact tracing strategy. This is crucial for a disease where a known positive case can infect 10-15 additional people a year. Tuberculosis control in Pakistan is hampered by funding challenges and other systemic barriers such as a lack of skilled human resources and inadequate drug supplies, despite the disease having one of the highest burdens in the world. Despite being a notifiable disease, active case detection, contact tracing, and reporting are very low across the country ^[25].

In accordance with the research conducted, several other studies also reported a lack of human resources as a significant obstacle to the coverage of TB contact investigations ^[26, 27]. In urban areas of Uganda, health workers have other competing responsibilities, leaving them with insufficient time to undertake activities at the community level, including household contact tracing ^[26].

Conclusion

The use of the Ishikawa diagram in problem-solving allows for the identification of various causal factors involved in complex problems. This diagram organizes causal factors into separate categories, such as Environment, Machine, Cost, Method, and People. Through this approach, the Ishikawa diagram supports structured analysis in identifying the root causes of a problem. This method has proven effective in mapping the relationship between cause and effect, thus helping researchers focus on more accurate and efficient solutions. In addition, this diagram also encourages teamwork by organizing various causal factors in a systematic and easy-to-understand manner.

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