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# ENHANCING TUBERCULOSIS CASE FINDING THROUGH SULI SIMULATOR APP: A CASE STUDY IN LUBUKLINGGAU CITY, SOUTH SUMATERA PROVINCE, INDONESIA

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**ABSTRACT**

**Introduction:** Tuberculosis (TB) remains a significant public health challenge and is included as one of the targets in the Sustainable Development Goals (SDGs). TB case finding in Lubuklinggau City decreased from 967 in 2019 to 273 (24,37%) in 2020. **Aims:** This study aims to analyze the TB disease management program strategy implementation in contact investigation activities by utilizing the SULI SIMULATOR application. **Method:** A qualitative design with a participatory action research (PAR) approach was employed, involving focus group discussions, in-depth interviews with 36 informants, and document review. Data were validated using triangulation methods and sources, followed by thematic analysis. **Result:** The findings revealed that, in terms of input, some PHC lacked analysts in their human resources. In terms of process, the successful implementation of the TB disease prevention program, with the application of SULI SIMULATOR for TB contact investigation, led to an increase in the case detection rate (CDR) to 255 cases (22.76%) in 2021 compared to the previous year's 237 patients (21.16%). **Conclusion:** The active involvement of the community and family is crucial in promoting early detection of TB cases through contact investigation activities, as well as providing support for treatment in family and community-based health efforts.

**Keywords**: tuberculosis, contact investigation, cadres, SULI SIMULATOR application

## INTRODUCTION

Controlling tuberculosis (TB) is a key priority in the Sustainable Development Goals (SDGs). The World Health Organization (WHO) designates High Burden Countries (HBC) based on rates of TB, HIV-TB, and MDR-TB. Indonesia is classified as an HBC due to its high burden across these indicators. According to the WHO's 2019 report, Indonesia ranks second globally, contributing 8.5% of all TB cases, after India (26%). TB-related mortality in Indonesia is significant, with an estimated 107,000 deaths annually, plus an additional 9,400 deaths from HIV-TB. Despite 842,000 TB cases each year, 32% remain undetected or unreported, posing a major public health risk. These challenges are intensified by factors such as TB-HIV co-infection, drug-resistant TB (DR-TB), and TB in children. To reach global elimination targets, Indonesia must focus on improving TB case detection, treatment strategies, and addressing these complex, interrelated health issues (Directorate General Disease Prevention And Control, 2019; Ministry of Health of RI, 2019; WHO, 2020).

In 2020, South Sumatra ranked 9th in TB cases in Indonesia, reporting 9,907 cases. Lubuklinggau City saw a 71.77% decrease to 273 cases, but treatment success and cure rates declined. The TB case detection rate dropped sharply to 16.55% in 2020, from 77.73% in 2019 (Lubuklinggau Health Office, 2019). Preliminary observations suggest that resource limitations, such as insufficient healthcare workers and infrastructure, and challenges in contact investigations, hinder the effectiveness of the city's TB prevention program.

The Lubuklinggau government is enhancing TB case detection through the

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SULI SIMULATOR (Surveillance Linggau Infectious and Vector-Borne Disease Reporting Information System), an iOS-based smartphone app integrated with a Geographic Information System (GIS). Accessible via web https://suli-simulator.com/lapor/ and Android, this platform supports real-time data collection and decision-making for managing infectious diseases. It helps identify TB infection sources by involving community health cadres in contact investigations. Data are verified by TB program managers and monitored by the health office, enabling timely treatment follow-up through health centers.

Integrating Information Communication Technology (ICT) in healthcare is essential for building a robust system and reducing disease transmission, especially during crises like the COVID-19 pandemic (Ye, 2020). This study aims to explore the implementation of SULI SIMULATOR for TB prevention at Community Health Centers in Lubuklinggau City, aiming to improve case detection, management, and overall control of TB.

## METHODS

A descriptive qualitative research was conducted at the Lubuklinggau Health Office and ten health centers across Lubuklinggau City, including Citra Medika, Sidorejo, Maha Prana, and others. Utilizing a Participatory Action Research (PAR) approach, the study followed four stages: reconnaissance, planning, acting and observing, and reflecting, between July and October 2021. Thirty-six informants were selected through purposive sampling, including policymakers and TB program stakeholders. Data collection included focus group discussions (FGDs) with health center staff and TB managers, followed by in-depth interviews with six key personnel from the Lubuklinggau Health Office. Observations were made using a checklist. Data credibility was ensured through triangulation, prolonged observation, and reliability audits. Thematic analysis was used for data interpretation, and informed consent was obtained. The study was approved by the Universitas Sriwijaya Health Research Ethics Committee (Protocol No.: 214/UN9.FKM/TU.KKE/2021)..

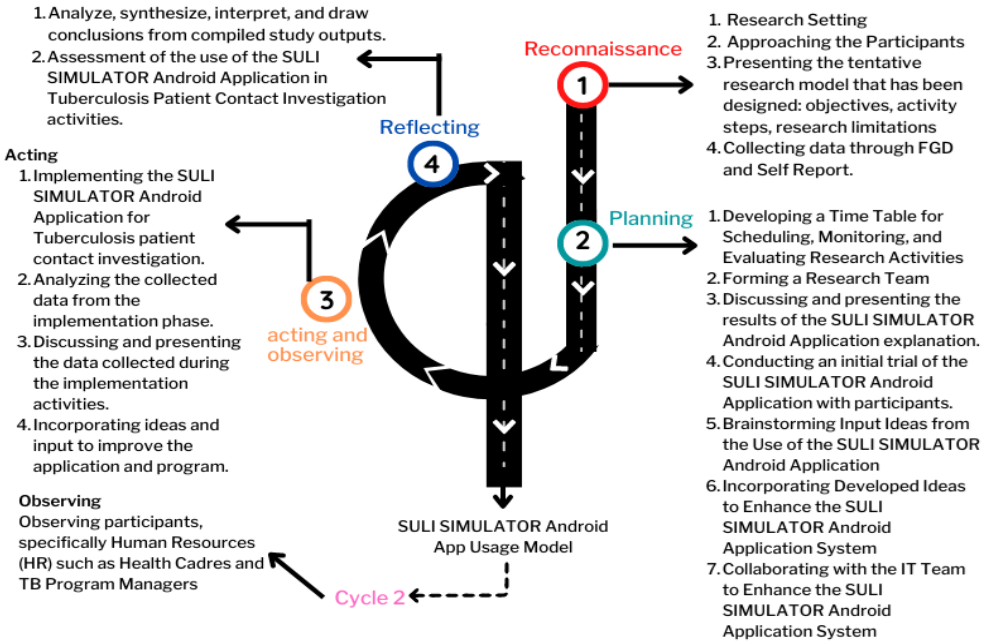


**Figure 1.** Research Process using PAR

**Table 1.** Characteristics of research informants

| No. | Informants | Total informants | Code |
|---|---|---|---|
| 1. | Head of Health Office | 1 | WD1 |
| 2. | Head of Program Division of Disease Control and Eradication | 1 | WD2 |
| 3. | Head of Communicable Disease Prevention and Control Section | 1 | WD3 |
| 4. | Deputy Tuberculosis Supervisor | 1 | WD4 |
| 5. | Data Officer TB | 1 | WD5 |
| 6. | IT Staff of Communication and Information Agency | 1 | WD 6 |
| 7. | Head of Health Center | 10 | WK |
| 8. | PHC TB program manager | 10 | FP |
| 9. | TB Cadre Health Center | 10 | FK |

*Notes:
WD : Wawancara Dinar or Health Office interview (interview of Head of Health Office; Head of Program Division of Disease Control and Eradication (P2P); Head of Communicable Disease Prevention and Control Section (P2PM); Deputy Tuberculosis Supervisor; TB Data Officer, and IT Staff of Communication and Information)
WK : Wawancara Kepala Puskesmas or interview with head of PHC
FK : FGD Kader or FGD for Cadre
FP : FGD pengelola program or FGD for PHC TB program manager

## RESULT

Several themes were identified related to the increase in TB cases. These themes include understanding TB cadres, conducting TB investigations, implementing the SULI SIMULATOR application in TB investigation contacts, and addressing the challenges of TB investigations during the COVID-19 pandemic (Figure 2).

### The Input Component of Implementing TB Disease Prevention Program using SULI SIMULATOR Application

The input components for TB prevention include human resources and information technology (Table 2). Observations and document reviews show that health workers at the health centers, including doctors, TB managers, and analysts, meet the qualifications outlined in Permenkes No. 67 of 2016 and have received TB prevention training at the Lubuklinggau City Health Office. These officers also have official documents, such as a Task Order (SPT) and a team decree from the head of the PHC. However, some health centers face challenges in sputum examination due to a shortage of analysts, caused by promotions, job transfers, or vacancies.

The use of information technology in the Tuberculosis Information System (SITB) supports key activities like TB data reporting, case identification, monitoring, and evaluation. TB managers at health centers have been trained on SITB by the South Sumatra Provincial Health Office. Case-finding reports are submitted through manual forms and the SULI SIMULATOR application. Manual data entry for TB Form 01 is done by the Health Office's TB Data Officer, who submits photos. The SULI SIMULATOR application facilitates community-based TB reporting, involving TB cadres, health center managers, and the TB Wasor at the Health Office in multiple stages.

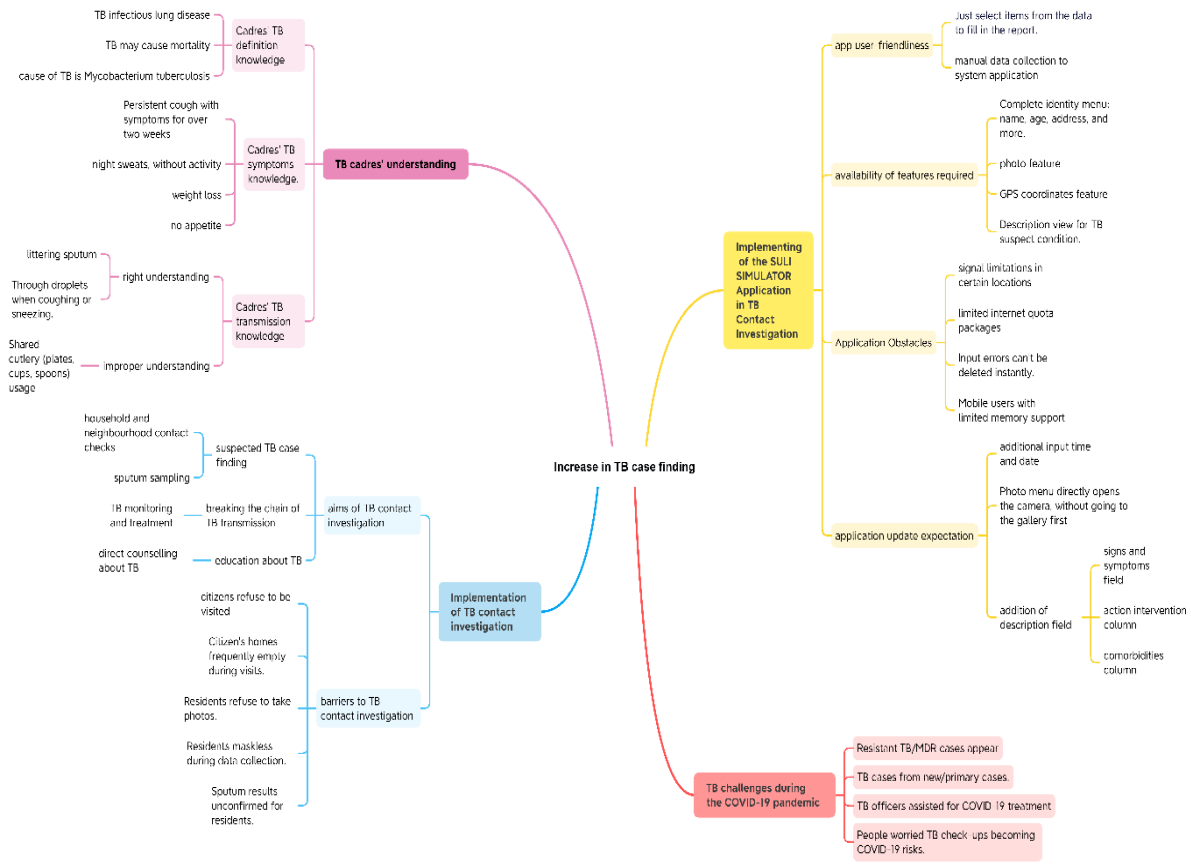


**Figure 2.** Themes from research findings

**Table 2**. Recapitulation of input component

| Interpretation | Subtheme | Theme |
|---|---|---|
| a. Health Office:<br>Head of Department, Head of P2P, Head of P2PM Section, TB Program Manager or Deputy Supervisor (Wasor) of TB, TB Data Officer (DO).<br>b. PHC:<br>Head of Community Health Center, TB Manager, Doctor, Analyst and TB cadres. | Availability of HR/Health Workers | HR/Health Workers for TB Prevention Program |
| - Letter of Order to Carry out Duties (SPMT) from the Head of Lubuklinggau City Health Office for TB Wasors and TB DOs.<br>- Decree on the determination of the TB officer team at the PHC from the head of the PHC | Qualifications of HR/Health Workers | |
| - TB deputy supervisors, TB DOs, and TB teams at Community Health Center have attended TB prevention training. | Improved HR/Health Worker skills | |
| SITB (Tuberculosis Information System), manual report format, and SULI SIMULATOR App. | Technology / IT Applications for TB data reporting, TB | Technology / IT Application for TB |

| Interpretation | Subtheme | Theme |
|---|---|---|
| | case identification, monitoring and evaluation | Prevention Program |
| TB managers have attended and received SITB training. | Enhanced skills in using technology | |

**The Process Component of Implementing TB Disease Prevention Program using SULI SIMULATOR Application**

This research phase concentrates on a specific facet of the TB elimination strategy, which involves enhancing community self-reliance in TB control by involving TB cadres, TB program managers, and TB supervisors in TB contact investigation activities utilizing the SULI SIMULATOR application.

The PHC and Lubuklinggau Health Office implemented various initiatives to enhance community self-reliance in TB control, encompassing engaging cadres in contact investigation, case reporting, treatment assistance, and counselling services. Additionally, they devised an innovative program for TB case finding involving active participation from cadres and the community. Furthermore, TB prevention activities through contact investigation were facilitated using the SULI SIMULATOR application (Table 3).

**Table 3.** A summary of the enhanced community self-reliance in the process component

| Interpretation | Subtheme | Theme |
|---|---|---|
| - Cadres involved in TB contact investigation<br>- Reporting of TB case finding through the SULI SIMULATOR application<br>- Cadres involved in "Notok Pintu" activity<br>- Training and decree on activities | Cadre empowerment for case finding | The role of the community in TB promotion, case finding and treatment support. |
| - Cadres are involved in JAMUMITU (Jangan Malu Kami Bantu or Don't Hesitate, We're Here to Help) activities for consultation, drug collection, Supplementary Feeding, and counselling.<br>- TB cadres and patients' families are involved as medicine-taking assistants | Cadre empowerment for treatment support | |
| - TB cadres conduct TB counselling on prevention, transmission, and treatment for people diagnosed with positive TB.<br>- TB cadres and patients' families are involved in counselling on Clean and Healthy Living Behavior. | Cadre empowerment for health promotion support | |

**TB Cadres' Comprehension and TB Contact Investigation**

The comprehension level of TB cadres and PHC TB officers regarding the definition and symptoms of TB is generally high. However, a few TB cadres still possess misconceptions regarding the transmission mode. Furthermore, TB cadres exhibit proficient knowledge of

how to carry out TB Contact Investigation activities.

*"…Home visits are conducted to households of TB-positive patients and those who have recovered, covering the neighboring houses on all sides. During these visits, we inquire about the presence of coughing individuals among family members, which is duly recorded on the accompanying form…" (FK1)*

*"Subsequently, the recorded information is followed by the provision of a sputum pot to individuals exhibiting symptoms, which is then examined at the laboratory of the PHC…" (FK9)*

Nevertheless, various obstacles were encountered during the execution of contact investigation activities by TB cadres and TB program managers. These include resistance encountered during cadre visits, frequent unavailability of residents at their homes, residents' reluctance to be photographed, non-compliance with health protocols such as mask-wearing during interviews, and lack of notification regarding examination results to the community (Table 4).

**Table 4.** A summary of the TB cadres' comprehension of TB and TB contact investigation within the process component

| Interpretation | Subtheme | Theme |
|---|---|---|
| - TB is a pulmonary disease.<br>- TB is a highly contagious and hazardous infectious disease.<br>- TB can lead to mortality. | Adequate understanding of the definition of TB | The comprehension level of cadres regarding the definition, signs, symptoms, and modes of transmission of TB disease. |
| - Common TB symptoms: persistent cough with phlegm for over two weeks, difficulty breathing, and chest pain.<br>- TB coughing includes blood.<br>- TB is marked by symptoms like reduced appetite, weight loss, and night sweats. | Adequate understanding of the symptoms of TB | |
| - TB's etiology is attributed to the Mycobacterium tuberculosis bacterium.<br>- Transmission occurs via respiratory droplets expelled during coughing and sneezing.<br>- TB is transmitted by conversations directly with the patient<br>- Improper disposal of sputum | Adequate understanding of the TB transmitted | |
| - TB is transmitted through shared utensils such as plates, spoons, cups, and glasses. | Inadequate understanding of the TB transmitted | |
| - Home visits are conducted to TB patients' residences.<br>- Visits are made to neighboring households on both sides of the TB patient.<br>- Tracing activities extend to nearby houses in the vicinity of the TB patient.<br>- Contact screening is carried out through home visits<br>- Family members' data are collected by filling out the TB.16 form | Adequate cadre's understanding of the TB contact investigation | Cadres' comprehension of contact investigation activities |

| Interpretation | Subtheme | Theme |
|---|---|---|
| - Direct sputum collection when TB symptoms are identified<br>- Referring individuals to the health center when TB is identified<br>- Provides TB counseling | How to conduct contact investigation activities | Barriers to TB contact investigation |
| - Families rejecting cadre visits<br>- Individuals withholding truthful information during data collection<br>- Missing sputum pots provided | Rejecting cadre visits | |
| - During data collection, the family and the surrounding community did not adhere to mask-wearing protocols. | Community did not adhere to health protocols. | |
| - The delivery of sputum pots was coordinated with the TB manager at the Primary Health Center (PHC)<br>- The residents were not informed of the results of their sputum examinations.<br>- No written examination results | Sputum examination flow and results | |

TB managers, like cadres, understand TB contact investigation well. However, amid the COVID-19 pandemic, TB cases face challenges such as an increase in drug-resistant TB (MDR TB) cases. New or primary TB cases are prevalent, and deploying personnel for COVID-19 duties poses a challenge. Public aversion to seeking TB examinations at healthcare facilities due to the pandemic is also a concern (Table 5).

**Table 5.** A summary of the TB managers' comprehension of TB and TB contact investigation within the process component

| Interpretation | Subtheme | Theme |
|---|---|---|
| - TB close contact screening<br>- Early identification of TB cases<br>- Visiting TB patients' residences<br>- Screening individuals in contact with TB patients<br>- Screening close household contacts<br>- Providing TB counseling to the community<br>- Monitoring TB treatment<br>- Screening close contacts of TB patients | Adequate understanding of the definition of TB | TB managers' comprehension of contact investigation activities |
| - Contact investigation through early detection<br>- Conducted Sputum collection<br>- Implementing patient treatment activities<br>- Referring patients to health centers<br>- Performing TB screening examinations<br>- Delivering counseling sessions on TB | Adequate understanding of the implementing TB contact investigation | |
| - TB contact investigation (CI) identifies TB cases<br>- CI as early detection of TB cases<br>- CI potential disrupts TB transmission chain.<br>- CI serves as a mechanism for tracking TB cases.<br>- CI as monitoring of TB treatment | TB contact investigation can improve TB case detection and break the | The role of TB contact investigation |

| Interpretation | Subtheme | Theme |
|---|---|---|
| - CI collects data directly from individuals with TB symptoms | transmission chain. | |
| - People rarely visit health centers during the pandemic.<br>- Many people stay at home despite coughing.<br>- People worry about Covid-19 exposure.<br>- People fear cough symptoms and testing positive for Covid-19. | Low public awareness of health centers during a pandemic | TB case finding challenges during the Covid-19 pandemic |
| - Community healthcare attendance declines in pandemic<br>- PHC personnel are temporarily assigned to participate in Covid-19 response endeavors<br>- The prevalence of Multi-Drug Resistant (MDR) Tuberculosis cases is observed. | Decreased TB case finding during the pandemic | |
| - The emergence of new tuberculosis (TB) cases/primary cases | Increased TB cases | |
| - Irregular TB treatment regimens<br>- Patients are reluctant to visit healthcare facilities<br>- Insufficient involvement of the directly observed treatment (DOT) supervisor.<br>- The occurrence of drug-resistant TB (MDR) cases<br>- Misconception among some individuals that TB is a condition caused by exposure to toxins | TB treatment failure | |

**Implementing of SULI SIMULATOR App**

The SULI SIMULATOR application was implemented in tuberculosis (TB) contact investigation efforts. According to TB healthcare workers, the application offers convenience by allowing them to report data simply by selecting options from the menu. These menu options have been designed to mirror the previous manual reporting method used in the TB.16 form, thereby eliminating the need for healthcare workers to fill out paper forms again. Additionally, the features of the application have been customized to meet the required conditions.

*"...It's already in use, the form is easy to fill out, and it's not complicated. You just click, fill it out based on the conditions of the suspect found, and then we submit the results..." (FK2)*

*"…This application is simple. We can quickly fill it out. We don't need to fill it out manually in the data collection sheet book so we can send it through this application…" (FK9)*

Nevertheless, certain cadres perceived heightened workload due to the implementation. In addition, TB cadres encountered various challenges while utilizing the SULI SIMULATOR application, including poor internet signal and limited data quota, inadequate support from devices, and the requirement for consistent oversight and evaluation by the TB manager at the PHC. Moreover, TB cadres expressed their desire for further application enhancements, particularly regarding additional features like the description column and photo menu options (Table 6).

**Table 6.** Recapitulation of Implementing SULI SIMULATOR App

| Interpretation | Subtheme | Theme |
|---|---|---|
| - The app facilitates the sending data process<br>- The app simplifies TB suspects reporting<br>- The app improves the reporting process<br>- The app streamlines the transition from manual filling to digital application. | Facilitates the transition from manual reporting to digital application | TB case finding reporting using the SULI SIMULATOR app |
| - Filling out the report is simplified through a click-and-select approach.<br>- The application includes menus for entering the complete name, address, age, and identity information.<br>- A photo menu is provided for visual documentation.<br>- The GPS menu displays coordinate points when at the location.<br>- A description display allows for recording the condition of the TB suspect. | App has the necessary features and components | |
| - The application increases the workload of cadres.<br>- The application is not supported by low-quality cell phones. | Barriers to cadres using the app | |
| - This app is used by TB cadres and program managers.<br>- The application enables the reporting of new TB cases.<br>- Reporting occurs tiered, from cadres to TB managers at the Public Health Center level.<br>- TB program managers have direct access to the reported results from cadres.<br>- Manual reporting can be easily inputted into the application.<br>- The obtained data are accurate and valid.<br>- The app streamlines close contacts monitoring. | Reporting during TB contact investigation | Implementing SULI SIMULATOR app to TB contact investigation |
| - There are signal limitations in specific areas.<br>- There are limitations on data quota.<br>- It is not possible to enter a GPS coordinate | Limited signal and data quota | Challenges in utilizing the SULI SIMULATOR application |
| - Each photo needs to be entered individually.<br>- Obtaining photos of suspected TB patients poses challenges.<br>- Any input errors should be reported to the PHC admin.<br>- Regular checks should be conducted to review incoming reports. | Usage constraints in the menu display | |
| - An additional description field should be included.<br>- A description column is necessary for capturing the chief complaint, symptom signs, and comorbidities.<br>- It is essential to add an extra field for the date and time of report submission.<br>- The photo-taking feature should be expanded to allow capturing images directly from the camera and the gallery. | The addition of a description column menu should be implemented in three sections | SULI SIMULATOR app update expectation |

### The Output Component of Implementing TB Disease Prevention Program using SULI SIMULATOR Application

Following the development and observation of participants throughout the research period, it was found that TB cadres using the SULI SIMULATOR application successfully recorded 25 cases during the contact investigation activities conducted from July to October 2021.

The utilization of the SULI SIMULATOR application for TB contact investigation activities has the potential to enhance the detection of TB cases. In 2021, the case-finding rate in Lubuklinggau City rose to 255 patients (22.76%), representing an increase compared to the previous year's figure of 237 cases (21.16%) (Figure 3).

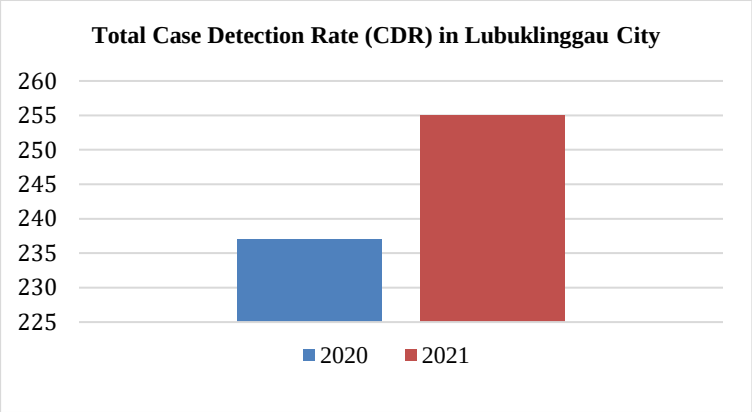


**Figure 3.** Total Case Detection Rate (CDR) in Lubuklinggau City

Furthermore, the application serves as a technological health innovation that expedites the process of case finding.

*"…Implementing this Contact Investigation accelerates the discovery process, indirectly contributing to the achievement rate of TB case finding in Lubuklinggau City…"(WD4)*

*"…Therefore, implementing this activity and its utilization by TB cadres proves to be highly beneficial in enhancing health innovation in technology…" (WD1)*

## DISCUSSION

Risk control is crucial in tuberculosis (TB) management, focusing on reducing transmission and incidence in the community. However, early case detection through contact tracing is challenging. Health information technologies like Geographic Information Systems (GIS) can significantly improve TB detection and control. GIS helps identify TB clusters that were previously undetectable, enhancing targeted screening efforts and disrupting transmission. In the US, GIS successfully detected TB outbreaks months before health authorities, identifying eight out nine outbreaks, with six detected 1 to 52 months earlier (Kammerer *et al.*, 2013). This highlights GIS's potential in early detection and controlling TB spread effectively.

### The Input Component of Implementing TB Disease Prevention Program using SULI SIMULATOR Application

Strategy implementation involves managing various forces that guide actions, prioritize efficiency, and require specialized leadership and motivation skills. It varies based on an organization's type and size, involving tasks such as restructuring, resource allocation, compensation programs, and improving management systems (David, 2012). In the context of the TB prevention program using the SULI SIMULATOR in

Lubuklinggau City, Donabedian's theory highlights the program's input, process, and output components. Human resources (HR) are essential inputs in achieving the program's vision, with skilled HR significantly impacting its success (Amaratunga and Baldry, 2002). Therefore, effective HR is key to program implementation.

The human resource availability at the Lubuklinggau City Health Center complies with Permenkes No.67 of 2016, which stipulates that the TB program implementation team at the Public Health Center (PHC) consists of 1 doctor, one nurse/TB officer, and one analyst (Ministry of Health Indonesia, 2016). Most tasks and responsibilities assigned to health workers involved in the TB control program at the Lubuklinggau City PHC have been carried out. However, there are still some tasks that have not been fully optimized. It is crucial for TB control in the PHC not to rely solely on the TB manager's responsibility but to seek support and collaboration from various stakeholders, including other health workers, cadres, and PMOs.

The PHC TB managers in Lubuklinggau City have undergone training related to TB prevention, aiming to enhance the officers' quality and performance. Furthermore, the Lubuklinggau City Health Office provides On Job Training (OJT) for new officers, including doctors and other health workers, to familiarize them with the procedures for TB control at the PHC. These efforts align with previous research highlighting the implementation of various types of training to develop TB cadres (NASRUDDIN, 2017). Such endeavors aim to enhance employees' productivity and develop human resources to address potential environmental changes (Soeprihanto, 2001). The availability of high-quality human resources is of utmost importance as the identification and treatment stage is the key to the success of the TB prevention program. The faster and more efficient the identification and treatment stage is executed, the greater the success of the TB prevention program (Colvin et al., 2019).

Furthermore, alongside SITB, introducing the SULI SIMULATOR application to TB cadres and PHC TB managers since the beginning of 2021 aligns with Article 21 of Permenkes No.67 of 2016, which addresses technology and information systems. According to the regulation, the Central Government and Local Governments must ensure the availability of integrated TB control technology and information systems to effectively implement TB control programs (Ministry of Health Indonesia, 2016). Spatially-based TB clustering proves highly valuable in TB control, particularly in areas characterized by low social determinants, which are populations at a heightened risk of TB (Wardani *et al.*, 2013).

**The Process Component of Implementing TB Disease Prevention Program using SULI SIMULATOR Application**

Enhancing community autonomy in TB control in Lubuklinggau City involves training and empowering TB health cadres who are assigned official roles and educated on using the SULI SIMULATOR application for TB contact investigations and case detection. This approach aligns with the Indonesian Ministry of Health's strategy to involve the community in TB promotion and control through family- and community-based health initiatives (Ministry of Health of RI, 2016).

Empowering the community includes educating them on preventing TB transmission, promoting healthy living, and eliminating stigma against TB patients. Collaboration with NGOs and other sectors is also crucial to reinforce prevention messages, focusing on hygiene and health practices. Furthermore, fostering TB patients' independence is essential, helping them accept their condition, adhere to treatment, and develop self-reliance. This

approach contributes to better health outcomes and empowers individuals to take charge of their recovery ; Noorratri, Margawati and Dwidiyanti, 2016).

This study shows that TB cadres possess strong knowledge of pulmonary TB symptoms and transmission, which plays a crucial role in shaping community awareness and encouraging active participation in TB prevention. Their efforts promote personal hygiene, environmental cleanliness, TB treatment utilization, and reduce stigma toward TB patients. Therefore, TB cadres must actively disseminate information and deliver appropriate messages during community activities (Kurniawan *et al.*, 2021). Furthermore, TB cadres and program managers at PHC have conducted contact investigations to break the TB transmission chain, as recommended by the Indonesian Ministry of Health. The involvement of TB cadres in contact investigations has contributed to the identification of 26.7% of new TB cases, emphasizing their critical role in early TB detection and intervention within the community (Directorate General of Disease Prevention and Control, 2019; Feronika, 2021).

Nevertheless, the TB contact investigation activities encountered challenges within the community in this study. A less receptive community can hinder health cadres' monitoring efforts regarding contact investigation (Alfaiza and Wuryaningsih, 2022). Moreover, low compliance with health protocols, particularly among TB patients, can contribute to the dissemination of TB bacteria to others (Syakbania and Wahyuningsih, 2020). PHC TB managers also face difficulties conducting contact investigations, especially amid the COVID-19 pandemic. The imposed lockdown due to COVID-19 has resulted in mental distress, diagnostic delays, non-adherence to treatment, and increased MDR TB cases (Marwah et al., 2021). The lockdown measures have also psychologically impacted TB patients, as they perceive it as burdensome and possess insufficient knowledge about the ongoing healthcare system. Consequently, patients exhibit fear in seeking services, leading to treatment failures requiring restarting from the beginning. Additionally, TB patients opt for alternative treatments or discontinue treatment altogether due to their apprehension about visiting healthcare facilities during the pandemic (Pamungkas and Yusuf, 2020).

Implementing the SULI SIMULATOR application in TB contact investigation activities demonstrates its user-friendly nature. Community-based TB surveillance information systems adhere to the principles of usefulness, ease of use, and user interest (Rahmasari, Nurjazuli and Adi, 2020). Consistent with previous research, utilizing the TB application downloaded on smartphones facilitates cadres' seamless transmission of information. They can effortlessly collect and submit TB-06 forms without the need to visit the PHC, enabling prompt reporting of individuals displaying TB symptoms (Kurniawan *et al.*, 2021). Digital technologies exhibit optimal performance when employed for patient care. While they are not a definitive solution, when effectively utilized, digital technologies offer a unique opportunity to strengthen healthcare systems, enhance patient care, and contribute to the global agenda for TB elimination (Lester *et al.*, 2019).

App development and refinement were conducted to enhance app effectiveness and resolve technical issues. Consistent with prior research, the evolution of TB support interventions transformed into mobile applications necessitates recommendations for enhancement (Iribarren et al., 2020). Consequently, during the reflection stage, an evaluation can be performed to assess actions to be undertaken in response to the previous process, problems, issues, and obstacles that emerged.

### The Output Component of Implementing TB Disease Prevention Program using SULI SIMULATOR Application

TB case investigation activities utilizing the SULI SIMULATOR application can potentially enhance the early detection of TB cases by TB cadres. The increase in case finding in Lubuklinggau City reached 255 points (22.76%), indicating a rise compared to the previous year's count of 237 patients (21.16%). Consistent with prior research, the effective implementation of the cadres' role in contact investigation can significantly contribute to the early identification of tuberculosis cases within the community (Feronika, 2021). Moreover, the attitudes, personalities, and motivation levels of TB cadres and managers are closely associated with the achievement of the CDR target for TB case finding (Farah, 2019; Vidyastari, Riyanti and Cahyo, 2019) .

The use of applications such as SULI SIMULATOR can improve the efficiency and effectiveness of health services, particularly in early TB case finding. Health policies that support the widespread integration of similar technologies in health services are essential. Although the application has yielded positive results, there is still a shortage of human resources in some health centers. Therefore, attention to strengthening human resources in terms of health analysts is needed to improve the capacity and effectiveness of health services. Active collaboration between health services and communities is also needed to improve TB prevention and control efforts.

This study used a Participatory Action Research (PAR) approach involving various informants, including stakeholders, cadres, and program holders involved in program implementation, providing comprehensive and representative data. However, this approach requires a long time to see significant results, which can pose challenges, especially for novice researchers. Additionally, the long cycle may lead to changes in context or conditions that could affect the study's results, making it difficult to isolate the effects of the implemented actions.

## CONCLUSIONS

Implementing the Tuberculosis disease prevention program through the SULI SIMULATOR application yielded optimal outcomes. Regarding the input component, the availability of human resources aligns with the stipulated requirements, although some PHC lack health analyst staff. The reporting technology comprised SITB and the SULI SIMULATOR application, facilitating contact investigation performed by TB cadres. Utilizing the SULI SIMULATOR application within the process component showcased its ease in reducing TB case finding. A notable increase in case-finding rates was observed within the output component, with 255 points (22.76%) compared to 237 patients (21.16%) in the previous year. The program's achievements are commendable as adequate inputs support them and conform to established standards. TB officers' active and innovative participation plays a pivotal role in the success of the TB program.

## REFERENCES

Alfaiza, S.N. and Wuryaningsih, C.E. (2022) ‘Pelaksanaan Program Directly Observed Treatment Short-Course (DOTS) Selama Pandemi COVID-19 di Wilayah Puskesmas Depok Jaya’, *Perilaku dan Promosi Kesehatan: Indonesian Journal of Health Promotion and Behavior*, 4(2), p. 57. https://doi.org/10.47034/ppk.v4i2.6345

Amaratunga, D. and Baldry, D. (2002) ‘Performance measurement in facililities management and its

relationships with management theory and motivation', *Facilities*, 20(10), pp. 327–336. https://doi.org/10.1108/02632770210443009

Colvin, C. *et al.* (2019) 'Quality of TB services assessment: The unique contribution of patient and provider perspectives in identifying and addressing gaps in the quality of TB services', *Journal of Clinical Tuberculosis and Other Mycobacterial Diseases*, 17, p. 100117. https://doi.org/10.1016/j.jctube.2019.100117

David, F.R. (2012) 'Strategic Manajement, Konsep Manajemen Strategis edisi 12'. Jakarta: Salemba Empat.

Directorate General Disease Prevention And Control (2019) 'Petunjuk Teknis Investigasi Kontak *Pasien Tbc Bagi Petugas Kesehatan Dan Kader*'. Jakarta: Ministry of Health of Republic Indonesia.

Directorate General of Disease Prevention and Control (2019) 'Technical Guidelines Contact Investigation of TB Patients For Health Workers Health Workers And Cadres'. Jakarta: Ministry of Health Indonesia..

Farah, N. (2019) *'Analisis Penerapan Learning Organization Dalam Upaya Peningkatan Capaian Angka Penemuan Kasus Tuberkulosis Di Puskesmas Kota Samarinda*. Universitas Airlangga.

Feronika, Y.F. (2021) 'Hubungan Peran Kader Tuberkulosis dalam Investigasi Kontak dengan Penemuan Kasus Tuberkulosis Baru di Wilayah Kerja Puskesmas Sukorambi Kabupaten Jember'. Universitas Muhammadiyah Jember.

Iribarren, S.J. *et al.* (2020) 'Converting and expanding mobile support tools for tuberculosis treatment support: Design recommendations from domain and design experts', *Journal of Biomedical Informatics*, 112, p. 100066. https://doi.org/10.1016/j.yjbinx.2019.100066

Kammerer, J.S. *et al.* (2013) 'Using statistical methods and genotyping to detect tuberculosis outbreaks', *International Journal of Health Geographics*, 12(Cdc), pp. 1–8. https://doi.org/10.1186/1476-072X-12-15

Kurniawan, D. *et al.* (2021) 'Peran Kader TB Dalam Pengembangan', *Jurnal Endurance : Kajian Ilmiah Problema Kesehatan*, 6(3), pp. 536–550. https://doi.org/10.22216/jen.v6i3.597

Lester, R. *et al.* (2019) 'Mobile phone short message service for adherence support and care of patients with tuberculosis infection: Evidence and opportunity', *Journal of Clinical Tuberculosis and Other Mycobacterial Diseases*, 16, p. 100108. https://doi.org/10.1016/j.jctube.2019.100108

Lubuklinggau Health Office (2019) '*Profile of Lubuklinggau City* Health Office 2019'. Lubuklinggau: Lubuklinggau Health Office.

Marwah, V. *et al.* (2021) 'Multidrug-resistant tuberculosis in COVID-19: Double trouble', *Medical Journal Armed Forces India*, 77, pp. S479–S482. https://doi.org/10.1016/j.mjafi.2021.05.002

Ministry of Health Indonesia (2016) *'Minister of Health Regulation No. 67/2016 on Tuberculosis Control*'. Jakarta: Ministry of Health Indonesia.

Ministry of Health of RI (2016) *'National Guidelines for Tuberculosis Control'.*

Ministry of Health of RI (2019) 'Petunjuk

Teknis Investigasi kontak Pasien TBC bagi Petugas Kesehatan dan Kader', *Dirjen Pencegahan dan Pengendalian Penyakit Menular* [Preprint].

Nasruddin, N. (2017) 'STRATEGI KADERISASI DAN PENGEMBANGAN SUMBER DAYA MANUSIA (SDM) KADER COMMUNITY TB CARE AISYIYAH DALAM PENANGGULANGAN TUBERKULOSIS (TB) DI KOTA MALANG'. University of Muhammadiyah Malang.

Noorratri, E.D., Margawati, A. and Dwidiyanti, M. (2016) 'Faktor Yang Mempengaruhi Efikasi Diri Pada Pasien TB Paru', *Journal of Nursing and Health*, 1(1), pp. 1–6.

Pamungkas, P. and Yusuf, M. (2020) 'DAMPAK PENGGOBATAN TUBERKULOSIS DITENGAH PANDEMI COVID 19', *Infokes*, 10(2), pp. 289–292.

Pratiwi, N.L. *et al.* (2012) 'Kemandirian Masyarakat dalam Perilaku Pencegahan Penularan Penyakit Tb Paru', *Buletin Penelitian Sistem Kesehatan*, 15(2). Available at:

Rahmasari, F.H., Nurjazuli, N. and Adi, K. (2020) 'Community-Based Surveillance Information System for Pulmonary Tuberculosis (Pulmonary TB)', *International Journal of English Literature and Social Sciences (IJELS)*, 5(5). https://doi.org/10.22161/ijels.55.4

Rosli, N.M., Shah, S.A. and Mahmood, M.I. (2018) 'Geographical Information System (Gis) Application in tuberculosis spatial clustering studies: A systematic review', *Malaysian Journal of Public Health Medicine*, 18(1), pp. 70–80.

Soeprihanto, J. (2001) *Penilaian kinerja dan pengembangan karyawan*. Yogayakarta: BPFE UGM.

Syakbania, D.N. and Wahyuningsih, A.S. (2020) 'Program Pencegahan dan Penanggulangan Tuberkulosis di Puskesmas', *Higeia Journal of Public Health Research and Development*, 1(3), pp. 84–94.

Vidyastari, Y.S., Riyanti, E. and Cahyo, K. (2019) 'Faktor-faktor yang memengaruhi pencapaian target CDR (Case Detection Rate) oleh koordinator P2TB dalam penemuan kasus di puskesmas Kota Semarang', *Jurnal Kesehatan Masyarakat*, 7(1), pp. 2356–3346.

Wardani, D.W.S.R. *et al.* (2013) 'Pentingnya Analisis Cluster Berbasis Spasial dalam Penanggulangan Tuberkulosis di Indonesia', *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*, pp. 147–151. https://doi.org/10.47034/ppk.v4i2.6345

WHO (2020) *Global tuberculosis report 2020*. Geneva.

Ye, J. (2020) 'The Role of Health Technology and Informatics in a Global Public Health Emergency: Practices and Implications From the COVID-19 Pandemic', *JMIR Med Inform*, 8(7), p. e19866. https://doi.org/10.2196/19866