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ASSOCIATED FACTORS IN TUBERCULOSIS CONTACT INVESTIGATION: STUDY FROM JANUARY TO SEPTEMBER 2024 IN BOYOLALI DISTRICT, INDONESIA

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Abstract: Tuberculosis (TB) contact investigation is a crucial part of the TB control strategy. Boyolali District has yet to reach the contact investigation target, with only 21.1% of cases having undergone contact investigation in September 2024, far below the targeted 90%. This study aims to identify factors associated with tuberculosis contact investigation in Boyolali District. Using a cohort retrospective study on bacteriological TB patients registered in the tuberculosis information system from January to September 2024. Individual data (age, gender, residence, history of TB treatment, and HIV status) and health facilities characteristics (ownership and type) were analyzed with chi-square and logistic regression. We found that contact investigation was primarily conducted in aged 31-40 years (24.3%) and 51-60 years (24.3%), male gender (63.5%), living in Boyolali District (94.6%), having no history of TB disease (70.3%), not knowing HIV status (94.6%), seeking treatment at government-owned health facilities (93.2%) at public health centers (75.7%). Chi-square analysis showed that residencies (p-value = 0.02), ownership of health facility (p-value = 0.00), and type of health facility (p-value = 0.01) were associated with case investigation. Logistic regression revealed that patients living in Boyolali District (p- value = 0.03; OR = 3.3; 95%CI = 1.15 – 9.56), those treated at government-owned health facilities (p- value = 0.01; OR = 3.7; 95%CI = 1.42 – 9.52), and those attending public health center (p- value = 0.00; OR = 2.4; 95%CI = 1.34 – 4.40) were more likely to be investigated for tuberculosis contact. Outreach to patients outside the district and those treated at private health facilities, particularly hospitals, is essential for improving TB contact investigation coverage. Furthermore, strengthening health facility coordination, health worker capacity, and regular evaluations are crucial for optimizing investigations and reducing TB transmission.

Keyword: tuberculosis, control program, contact investigation, residences, health facilities, cohort retrospective

Introduction

Tuberculosis (TB) is a contagious infectious disease caused by Mycobacterium tuberculosis (Mtb), and which spreads through the air when an individual with active pulmonary TB coughs, sneezes, speaks, or even sings, releasing tiny infectious droplets into the surrounding environment. If these airborne droplets are inhaled by another person, they may become infected with the bacteria. Individuals who have been bacteriologically confirmed as TB-positive but do not receive adequate and timely treatment are at significant risk of transmitting the disease to those around them, with the potential to infect up to ten people per year. Certain groups are particularly vulnerable to TB infection, especially those who have prolonged close contact with TB patients, such as family members living in the same household, children whose immune systems are still developing, the elderly whose immune responses have naturally declined with age, and individuals with weakened immune systems due to underlying health conditions. People suffering from malnutrition, individuals living with Human Immunodeficiency Virus (HIV), and those with other immunocompromising conditions are also at a heightened risk of developing TB if exposed to the bacteria. Among the total population infected with Mycobacterium

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tuberculosis, it is estimated that approximately 5-10% will progress to develop active TB at some point in their lifetime, especially if their immune system is unable to control the latent infection effectively (Ministry of Health of the Republic of Indonesia, 2019; Setyoningrum et al., 2024).

Indonesia is currently ranked as the country with the second-highest TB burden in the world, reflecting both the high number of TB cases and the substantial challenges faced in controlling and mitigating the disease. In 2023, it was estimated that the total number of TB cases in Indonesia reached approximately 1,060,000. However, the number of cases that were successfully identified, diagnosed, and recorded within the national health surveillance system amounted to only 821,200. This comparison indicates that 22.5% of the estimated cases remain undetected and untreated. This implies a perpetual cycle of transmission that poses a significant threat to public health. Because many individuals are undiagnosed and untreated, it makes TB control efforts even more difficult. The challenge of TB control is further exacerbated by the emergence of various complex and coexisting conditions that hinder effective disease management. These include TB-HIV coinfection, which increases morbidity and complicates treatment outcomes; drug-resistant TB (DR-TB), which requires prolonged and more complex treatment regimens; TB cases associated with comorbidities, which necessitate integrated management approaches; and TB among children, who are more vulnerable to severe forms of the disease due to their developing immune systems (Ministry of Health of the Republic of Indonesia, 2019, 2024; Nawi et al., 2018).

Responding to this situation, Indonesia has adopted an active case-finding strategy as a TB control program, one of which is Contact Investigation (CI). This approach aims to detect potential TB cases as early as possible. Designed to systematically identify, trace, and screen individuals who have had close or prolonged exposure to a confirmed TB patient. Through comprehensive contact investigation, TB cases can be immediately identified and treated, thereby preventing further transmission in the community. Early diagnosis and treatment of TB cases play a crucial role in breaking the chain of infection and ultimately reducing the overall disease burden (Ministry of Health of the Republic of Indonesia, 2019; Putra et al., 2019).

As part of the national strategy to enhance TB contact investigation efforts, the government has set a target coverage of 90% for contact investigation among bacteriologically confirmed index cases by the year 2024. However, national contact investigation coverage in 2022 had only reached 35%, with Central Java Province recording a higher coverage of 62%. In Boyolali District, contact investigation coverage continues to fluctuate and has not met the set target. In 2022, contact investigation coverage was recorded at 28.7%, then increased to 56.4% in 2023. However, by the third quarter of 2024 (January – September), contact investigation coverage decreased to 21.1% (Tuberculosis Information System, 2024). This suboptimal achievement raises concerns regarding the effectiveness of active case finding as an effort to reduce TB transmission. Therefore, this study aims to identify factors that influence the implementation of contact investigations, and assess their influence to support the improvement of TB control program strategies and outcomes.

Materials and Methods

This study used a retrospective cohort design using secondary data from the tuberculosis information system (SITB), where information is recorded systematically. Using data of bacteriologically confirmed TB patients registered in the Tuberculosis Information System from January to September 2024, data were checked for completeness and duplicate entries removed and variables were coded for statistical analysis. The dependent variable in this study is contact investigation for bacteriologically confirmed TB cases, and the independent variables included individual characteristics (age, gender, residence, TB treatment history, and HIV status) and health facility characteristics (ownership and type of health facility). Data were analyzed by univariate analysis to identify the frequency distribution of each variable, chi-square to determine the relationship between independent and dependent variables, and logistic regression to describe the strength of the relationship between independent and dependent variables.

Results and Discussion

Based on the findings presented in Table 1, out of a total of 350 bacteriologically confirmed tuberculosis (TB) patients included in this study, only 74 (21.1%) had contact investigations conducted. In contrast, the remaining 276 patients, representing 78.9% of the study population, did not have any contact investigation conducted. This indicates that the overall coverage of contact investigation remains low, highlighting a significant gap in the implementation of active case-finding efforts.

From a demographic perspective, contact investigation was most common among patients aged 31-40 years (24.4%) and 51-60 years (24.3%), which are the productive and pre-elderly ages. In addition, the majority of patients undergoing contact investigation were male (63.5%) compared to female (36.5%). In terms of residence, almost all patients who underwent contact investigation lived in Boyolali Regency (94.6%), while the other 5.4% came from outside the region. Most contact-investigated patients had no previous history of TB (70.3%) and most contact-investigated patients did not know their HIV status (94.6%).

Regarding the health facilities where patients were treated, contact investigations were more common among TB patients in public health facilities (93.2%) than private health facilities (6.8%). By facility type, public health centres (puskesmas) had the highest contact investigation rate, with a proportion of 75.7%. This indicates the dominant role of government health facilities, particularly health centres, in supporting the implementation of TB contact investigations

Table 1: Sociodemographic Characteristics and Chi-square Analysis

TB Contact Investigation	Yes	No	Total	P-value
	N (%)	N (%)	N (%)	
n (%)	74 (21.1)	276 (78.9)	350 (100.0)	

Age (years)				0.23
11-20	2 (2.7)	17 (6.2)	19 (5.4)	
21-30	6 (8.1)	34 (12.3)	40 (11.4)	
31-40	18 (24.3)	38 (13.8)	56 (16.0)	
41-50	12 (16.2)	41 (14.9)	53 (15.1)	
51-60	18 (24.3)	71 (25.7)	89 (25.4)	
61-70	13 (17.6)	44 (15.9)	57 (16.3)	
71-80	4 (5.4)	30 (10.9)	34 (9.7)	
81-90	1 (1.4)	1 (0.4)	2 (0.6)	
Gender				0.42
Male	47 (63.5)	161 (58.3)	208 (59.4)	
Female	27 (36.5)	115 (41.7)	142 (40.6)	
Domicile				0.02
Boyolali District	70 (94.6)	232 (84.1)	302 (86.3)	
Outside Boyolali	4 (5.4)	44 (15.9)	48 (13.7)	
TB Treatment History				0.25
New	52 (70.3)	204 (73.9)	256 (73.1)	
Treated after failing category 1	0 (0.0)	5 (1.8)	5 (1.4)	
Relapse	0 (0.0)	5 (1.8)	5 (1.4)	
Unknown	22 (29.7)	62 (22.5)	84 (24.0)	

HIV Status				0.11
HIV Negative	4 (5.4)	39 (14.1)	43 (12.3)	
HIV Positive	0 (0.0)	1 (0.4)	1 (0.3)	
Unknown	70 (94.6)	236 (85.5)	306 (87.4)	
Ownership of Health Facilities				0.00
District/City Government	69 (93.2)	218 (79.0)	287 (82.0)	
Private	5 (6.8)	58 (21.0)	63 (18.0)	
Type of Health Facilities				0.01
Clinic	1 (1.4)	5 (1.8)	6 (1.7)	
Public Health Centre (*Puskesmas*)	56 (75.7)	156 (56.5)	212 (60.6)	
Hospital	17 (23.0)	115 (41.7)	132 (37.7)	

The results of bivariate analysis with chi-square shown in table 1 indicate that several variables had a significant association ($p < 0.05$) with the implementation of contact investigation. Patient residence ($p = 0.02$), ownership of a health facility ($p = 0.00$) and type of health facility ($p = 0.01$) had significant associations. In contrast, other variables such as age ($p = 0.23$), gender ($p = 0.42$), TB treatment history ($p = 0.25$), and HIV status ($p = 0.11$) did not show statistically significant associations, despite differences in the proportion of TB contact investigations conducted.

Further analysis using logistic regression, as shown in Table 2, provides additional insights into the factors influencing TB contact investigations. The results reveal that TB patients living in Boyolali District (OR: 3.32; 95% CI: 1.15-9.56; p=0.03), those treated at government-owned health facilities (OR: 3.67; 95% CI: 1.42-9.52; p=0.01), and those attending public health centres (puskesmas) (OR: 2.43; 95% CI: 1.34-4.40; p=0.00) were more likely to be investigated for tuberculosis contact. Meanwhile, TB patients attending clinics showed no significant association with contact investigation (OR: 1.79; 95% CI: 0.21-15.70; p=0.53).

Table 2: Logistic Regression Analysis

Factor	**Odds Ratio**	**95%**	**p-value**

		Conf. Interval	
Domicile			
Boyolali District	**3.32**	**1.15 – 9.56**	**0.03**
Outside Boyolali	**Reference**	**-**	**-**
Ownership of Health Facilities			
District/City Government	**3.67**	**1.42 – 9.52**	**0.01**
Private	**Reference**	**-**	**-**
Type of Health Facilities			
Clinic	**1.79**	**0.21 – 15.70**	**0.53**
Public Health Center (*puskesmas)*	**2.43**	**1.34 – 4.40**	**0.00**
Hospital	**Reference**	**-**	**-**

Contact investigation (CI) involves a home visit to the TB patient (index case) by a cadre or health worker in the area where the patient lives, to screen all household contacts in the vicinity of the TB patient. Priority is given to household contacts, with a target of at least eight people being investigated per index case. Although the focus was on household contacts, investigations were also conducted on close contacts in other settings such as workplaces, dormitories, schools, daycare centres, prisons, and other similar places. TB patients living in Boyolali District had more contacts investigated than TB patients living outside Boyolali District. This is because cross-district cases often require additional administrative procedures and coordination between districts, which can result in delays in contact investigation. Also, inconsistencies in policy implementation across districts can hamper the effectiveness of contact investigations. (Fox et al., 2011; Havumaki et al., 2021; Ministry of Health of the Republic of Indonesia, 2023; Salazar-Austin et al., 2022).

There is a difference between TB patients who are treated in government facilities compared to those who are treated in private facilities. Private facilities have fewer contact investigations than government health facilities. Support for funding, resources, and technical guidance are factors that make government facilities better. Where they have the capacity to contribute to the implementation of comprehensive contact investigations compared to private facilities that may not fully comply with national protocols (Adams & Botha, 2024; Daniels et al., 2022; Newell et al., 2004).

The main role of the Community Health Center (Puskesmas) in controlling TB through a community-based approach, including implementing contact investigations, has greater opportunities than those in hospitals. If there is a patient diagnosed with TB in a hospital or clinic, then the patient data will be loaded into a digital platform that manages TB case data nationwide called the Tuberculosis Information System (SITB). Subsequently, the patient will be referred to the public health centre (puskesmas) in their area of residence for contact investigation. Alternatively, hospitals and clinics can also communicate directly with the relevant health centre. After receiving the referral, the health centre will coordinate with health cadres or local communities to effectively carry out contact investigations in the patient's neighbourhood. Proper coordination between hospitals or clinics and health centres helps increase the effectiveness of TB control in referring index cases, thus ensuring optimal contact investigations (Bonnet et al., 2023; Ministry of Health of the Republic of Indonesia, 2019; Martínez-Campreciós et al., 2024).

Systematic review suggests that detection of new TB cases, especially among households or close contacts is very effective using contact investigation methods. Early identification of someone at high risk can provide an opportunity for faster treatment. Hence, this approach allows preventing further spread of TB. However, it should be emphasized that to increase the coverage and effectiveness of TB contact investigations, good coordination between Health facilities and the Community is needed (Velen et al., 2021).

This study has limitations because it only uses secondary data, so it relies heavily on the completeness and quality of the available data. One possible obstacle is incomplete reporting of contact investigation results, which may affect the accuracy of the analysis results. Therefore, further research is recommended to use primary data to obtain more detailed and valid information, especially regarding aspects of health workers' skills in supporting a thorough contact investigation process.

Conclusion

the study conducted in Boyolali district from January to September 2024, showed that Tuberculosis (TB) contact investigations were mostly carried out on TB patients domiciled in Boyolali district and who were treated at government health facilities, especially health centres (puskesmas). There needs to be outreach to patients outside the district and patients who were treated at private health facilities can increase the scope of TB contact investigations. In addition, TB contact investigations can be efficient if there is strong coordination between inter-regional and inter-facility coordination. Moreover, increasing the capacity of health workers and periodic evaluations are very necessary to optimize TB investigations in order to find TB cases earlier and reduce TB transmission.

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References

Adams, R., & Botha, M. (2024). Cervical cancer prevention in Southern Africa: A review of national cervical cancer screening guidelines in the Southern African development community. Journal of Cancer Policy, 40, 100477. https://doi.org/10.1016/j.jcpo.2024.100477

Bonnet, M., Vasiliu, A., Tchounga, B. K., Cuer, B., Fielding, K., Ssekyanzi, B., Tchakounte Youngui, B., Cohn, J., Dodd, P. J., Tiendrebeogo, G., Tchendjou, P., Simo, L., Okello, R. F., Kuate Kuate, A., Turyahabwe, S., Atwine, D., Graham, S. M., Casenghi, M., Chauvet, S., ... Nahabwe, M. (2023). Effectiveness of a community-based approach for the investigation and management of children with household tuberculosis contact in Cameroon and Uganda: A cluster-randomised trial. The Lancet Global Health, 11(12), e1911–e1921. https://doi.org/10.1016/S2214-109X(23)00430-8

Daniels, B., Shah, D., Kwan, A. T., Das, R., Das, V., Puri, V., Tipre, P., Waghmare, U., Gomare, M., Keskar, P., Das, J., & Pai, M. (2022). Tuberculosis diagnosis and management in the public versus private sector: A standardised patients study in Mumbai, India. BMJ Global Health, 7(10), e009657. https://doi.org/10.1136/bmjgh-2022-009657

Fox, G. J., Dobler, C. C., & Marks, G. B. (2011). Active case finding in contacts of people with tuberculosis. The Cochrane Database of Systematic Reviews, 2011(9), CD008477. https://doi.org/10.1002/14651858.CD008477.pub2

Havumaki, J., Cohen, T., Zhai, C., Miller, J. C., Guikema, S. D., Eisenberg, M. C., & Zelner, J. (2021). Protective impacts of household-based tuberculosis contact tracing are robust across endemic incidence levels and community contact patterns. PLOS Computational Biology, 17(2), e1008713. https://doi.org/10.1371/journal.pcbi.1008713

Martínez-Campreciós, J., Gil, E., Aixut, S., Moreno, M., Zacarias, A., Nindia, A., Gabriel, E., Espinosa-Pereiro, J., Sánchez-Montalvá, A., Aznar, M. L., & Molina, I. (2024). Tuberculosis contact tracing, Angola. Bulletin of the World Health Organization, 102(3), 196–203. https://doi.org/10.2471/BLT.23.290068

Ministry of Health of the Republic of Indonesia. (2019). Petunjuk Teknis Investigasi Kontak Pasien TBC bagi Petugas Kesehatan dan Kader. https://htbs.tbindonesia.or.id/wp-content/uploads/2020/03/Petunjuk-Teknis-Investigasi-Kontak.pdf

Ministry of Health of the Republic of Indonesia. (2023). Surat Edaran Perubahan Pelaksanaan Kegiatan Investigasi Kontak dan Terapi Pencegahan Tuberkulosis di Indonesia.

Ministry of Health of the Republic of Indonesia. (2024). Data Kondisi TBC – TB Indonesia. https://www.tbindonesia.or.id/pustaka-tbc/data-kondisi-tbc/

Nawi, A. M., Ahmad, N., Yusof, S. N., Ahmad, N., Nor, Z. M., Noor, J. M., Ghazi, H. F., Jeffree, M. S., & Hassan, M. R. (2018). Tuberculosis contact tracing in low- and middle-income countries: A systematic review. International Journal of Public Health Research, 8(1), Article 1.

Newell, J. N., Pande, S. B., Baral, S. C., Bam, D. S., & Malla, P. (2004). Control of tuberculosis in an urban setting in Nepal: Public-private partnership. Bulletin of the World Health Organization, 82(2), 92–98.

Putra, I. W. G. A. E., Kurniasari, N. M. D., Dewi, N. P. E. P., Suarjana, I. K., Duana, I. M. K., Mulyawan, I. K. H., Riono, P., Alisjahbana, B., Probandari, A., Notobroto, H. B., & Wahyuni, C. U. (2019). The implementation of early detection in tuberculosis contact investigation to improve case finding. Journal of Epidemiology and Global Health, 9(3), 191–197. https://doi.org/10.2991/jegh.k.190808.001

Salazar-Austin, N., Mulder, C., Hoddinott, G., Ryckman, T., Hanrahan, C. F., Velen, K., Chimoyi, L., Charalambous, S., & Chihota, V. N. (2022). Preventive treatment for household contacts of drug-susceptible tuberculosis patients. Pathogens (Basel, Switzerland), 11(11), 1258. https://doi.org/10.3390/pathogens11111258

Setyoningrum, R. A., Maharani, R. A., Hapsari, R., & Chafid, A. P. P. (2024). Risk factors of tuberculosis in children with adult household tuberculosis contact. Paediatrica Indonesiana, 64(4), 287–292. https://doi.org/10.14238/pi64.4.2024.287-92

Velen, K., Shingde, R. V., Ho, J., & Fox, G. J. (2021). The effectiveness of contact investigation among contacts of tuberculosis patients: A systematic review and meta-analysis. European Respiratory Journal, 58(6). https://doi.org/10.1183/13993003.00266-2021