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Barriers to Tuberculosis Contact Investigation Implementation in Ghana: A Convergent Mixed-Methods Study

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Research Article

Keywords: Tuberculosis, Contact investigation, Contact tracing, Contact disclosure, Implementation barriers, Healthcare providers, Implementation science, Ghana

Posted Date: October 30th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11025733/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Tuberculosis (TB) contact investigation identifies and manages individuals exposed to TB and supports early detection. However, implementation in high-burden settings faces challenges, and evidence on patient-level concerns and organizational barriers to TB contact investigation in Ghana is scarce. This study examined patient contact disclosure and patient-reported concerns, and explored provider-reported organizational and contextual barriers to implementation in selected healthcare facilities in Ghana's Ashanti Region

Methods

We conducted a convergent mixed-methods study across six healthcare facilities in three districts. Among 212 adults with pulmonary TB, quantitative data were collected using a structured questionnaire, and 25 healthcare providers participated in in-depth interviews. Patients were recruited consecutively and providers were purposively selected. Quantitative data were analyzed using descriptive statistics, chi-square tests, and logistic regression analyses. Qualitative data underwent deductive-inductive thematic analysis using the Consolidated Framework for Implementation Research (CFIR) as an analytic lens, and quantitative and qualitative findings were integrated during interpretation.

Results

Among the 212 participants, 82.5% had heard of TB contact investigation, 55.7% reported at least one contact, and 44.3% reported none. Among those reporting contacts, 71 reported fewer than four contacts and 47 reported four or more. Knowledge level was not significantly associated with contact disclosure ($\chi^2 = 2.717$, $p = 0.257$). In the adjusted analysis, participants aged 25–34 years (adjusted odds ratio [AOR] = 2.64, 95% Confidence Interval [CI]: 1.06–6.54; $p = 0.036$) and 45–54 years (AOR = 3.18, 95% CI: 1.42–7.13; $p = 0.005$) had higher odds of reporting contact disclosure than those aged ≥ 55 years. Frequently reported interpersonal concerns included family privacy (46.2%), fear of blame (43.9%), fear of judgment (40.1%), and concern that contacts might experience stigma if screened (38.2%). Providers reported workload, competing responsibilities, limited counselling time, transport constraints, staffing limitations, and coordination challenges.

Conclusions

TB contact investigation in setting occurred in multilevel context involving patient-reported concerns and provider-reported organizational and logistical constraints. Strengthening implementation may require patient-centered counselling addressing confidentiality, stigma and blame, alongside adequate time, staffing, transport and coordination support.

BACKGROUND

Tuberculosis (TB) remains a major global public health problem, with an estimated 10.7 million cases and 1.23 million deaths in 2024 (1). Patients with pulmonary TB (PTB) can transmit the infection to close contacts, making systematic identification and screening of exposed individuals' important components of TB prevention and

case detection (2). Tuberculosis control is not only concerned with the diagnosis and treatment of active cases but also the identification, screening, and prevention of those people exposed to TB from getting the infection or becoming sick with the disease. In contact investigation, healthcare providers identify and assess people who are believed to be in close contact with patients presenting with active PTB so that they can promptly implement preventive or therapeutic measures for such individuals as soon as possible (3–5).

For contact investigations to be effective, healthcare providers need to pay attention to the social and interpersonal concerns of patients to provide a suitable environment for them to willingly disclose their contacts for follow-up (5, 6). Healthcare providers, on the other hand, require adequate staff strength, work time, and counselling capacity, and logistical support to undertake contact investigations and follow-ups effectively (7).

Evidence indicates that TB contact investigation is influenced by both patient-level and healthcare system factors. Patient engagement may be affected by stigma, concerns about confidentiality, and fear of disclosure (6, 8). Awareness of contact investigation alone may not ensure engagement, as disclosure decisions can be shaped by social and interpersonal concerns (9).

Implementation also depends on adequate health system capacity. Studies in Ghana and other African settings have identified staff shortages, heavy workloads, and limitations in service delivery capacity as barriers to TB-related case finding and contact investigation (8, 10). Transport, follow-up, and logistical constraints have also been reported in household-contact-investigation programs (7, 11). A systematic review similarly identified understaffing, workload, transportation, limited counselling capacity, and institutional readiness as recurring implementation barriers in low- and middle-income settings (12).

The Ghana National TB Control Program (NTP) has a national guideline for TB contact investigation, including how to identify and screen close contacts of patients with PTB. However, looking at evidence from Ghana, challenges in TB service delivery that affect contact investigations include workload, limited logistics, inadequate supervision, and weaknesses in the implementation processes (13, 14). This study extends existing evidence by integrating patient-reported disclosure barriers with provider-reported organizational constraints within routine TB services, allowing implementation challenges to be examined across interpersonal and health-system levels. There is a need to gain more insight into the complementary determinants of these challenges to inform context-specific strategies for strengthening contact investigation in Ghana.

The Consolidated Framework for Implementation Research (CFIR) offers an integrated approach for examining determinants that influence implementation across various contexts (15, 16). In this study, TB contact investigation was conceptualized as a multilevel implementation process in which patient engagement and contact disclosure occur within an implementation environment shaped by provider capacity, organizational resources, logistical conditions, and implementation processes.

Therefore, the quantitative component examined patient-level patterns of contact disclosure, knowledge, and selected interpersonal concerns, while the qualitative component explored provider-reported organizational, contextual, and implementation barriers. CFIR was primarily used as an analytic lens to organize and interpret the provider-reported implementation determinants and to support the integration of the qualitative and quantitative findings, rather than as a prespecified causal model linking CFIR constructs directly to patient disclosure.

In this study, we aimed to examine patient-level factors associated with the disclosure of TB contacts and explore provider-reported organizational and contextual barriers to implementation, integrating the two strands to characterize the multilevel barriers to routine TB contact investigation. The quantitative component focused on

patient contact disclosure and factors potentially associated with disclosure, whereas the qualitative component focused on healthcare providers' perspectives on the organizational and contextual barriers to implementation.

The quantitative part focused on patient disclosure of TB contacts and the factors that might be involved in contact disclosure, while the qualitative part focused on healthcare providers' perspectives on organizational and contextual barriers to implementation.

METHODS

Study Design and Approach

This study used a convergent mixed-methods design and integrated a quantitative cross-sectional survey of patients with PTB and qualitative in-depth interviews with healthcare providers. The quantitative and qualitative components were conducted during the same study period, analyzed independently, and subsequently integrated. The quantitative component assessed patient disclosure of TB contacts and factors associated with disclosure, whereas the qualitative component explored healthcare providers' perspectives on counselling, workload, logistics, coordination, and other contextual barriers affecting the implementation of TB contact investigation.

Study Setting

This study was conducted in the Ashanti Region of Ghana, focusing on the Kumasi Metropolis, Asokwa Municipal, and Bosomtwe District. These three districts were purposively selected based on TB case notification and representation of urban and peri-urban settings.

Two healthcare facilities that provided TB services were purposively selected from each district based on TB case notification and program relevance: Suntreso Government Hospital and Manhyia Government Hospital in Kumasi Metropolis; Kumasi South Hospital and Christ the King Hospital in Asokwa Municipal; and Kuntanase Government Hospital and St. Michael's Hospital in Bosomtwe District. All six facilities provided routine TB diagnosis, treatment, and contact investigation services under the Ghana National Tuberculosis Program.

Study Population, Eligibility Criteria, and Participant Selection

This study included adults with PTB who received treatment at six selected facilities and healthcare providers involved in TB care or contact investigation. The quantitative component included 212 patients with PTB who were consecutively recruited. Eligible patients were aged ≥ 18 years, receiving TB treatment, and able to provide informed consent; critically ill patients who could not provide informed consent were excluded. The quantitative sample was derived from 382 PTB cases reported by the participating districts from July to December 2024. Because a complete 2025 population estimate was not available at the time of sample-size planning, the July–December 2024 caseload was used solely as an empirical estimate for the sample-size calculation. PTB population across the selected facilities. Yamane's formula ($n = N / (1 + N \cdot e^2)$) with $N = 382$ and $e = 0.05$ yielded a base sample of approximately 195. Applying a 10% allowance for nonresponse ($195 \div 0.90$) yielded a target of approximately 217 participants. Of the 217 patients targeted, 212 were successfully enrolled; the small shortfall reflected a few eligible patients who declined to participate or could not be reached within the data collection period.

Eligible healthcare providers included doctors, nurses, disease control officers, and community health workers involved in tuberculosis control or contact investigation. Facility management teams and tuberculosis focal persons

provided facility-specific lists of eligible participants for the study. Using these sampling frames, participants were purposively selected across professional cadres, facilities, and districts to capture diverse perspectives on implementation. Providers unavailable during the initial visit were contacted and scheduled for an interview following consent. Unavailable participants were replaced by the next eligible provider of the same cadre in the sampling frame.

Recruitment continued until data saturation was reached, assessed iteratively during data collection by reviewing emerging codes and comparing successive interviews against the study objectives. Saturation was considered to have been reached when successive interviews yielded no new codes relevant to the study objectives. Twenty-five healthcare providers were interviewed, comprising five medical officers, seven nurses, seven disease control officers, and six community health workers across the six participating facilities. This approach was consistent with the established guidance for purposeful sampling in mixed-methods implementation research and its application in tuberculosis implementation research (17, 18).

Data Sources, Instrument Development and Data Collection

Trained research assistants collected data from July 2025 to November 2025. Quantitative data were collected from eligible patients with PTB using structured questionnaires. The questionnaire was developed by adapting selected items from the WHO and Stop TB Partnership TB Stigma Assessment Toolkit (19, 20). The instrument covered socio-demographic characteristics, awareness and knowledge of TB contact investigation, contact disclosure, and patient-reported concerns related to stigma, disclosure and confidentiality. The final English-language version of the questionnaire used in the study is provided as additional file 1.

The questionnaire was reviewed for relevance and clarity and then refined after pretesting. Consistency was evaluated using Cronbach's alpha. The seven-item knowledge measure (C16–C22) showed acceptable consistency (Cronbach's $\alpha = 0.761$). The six-item barriers to contact disclosure and stigma, judgment, and privacy measures showed consistency (Cronbach's $\alpha = 0.942$; 0.961). Internal consistency was assessed for the multi-item sections as part of instrument quality assurance; however, because the study objectives focused on specific interpersonal barriers rather than latent barrier or stigma constructs, individual items were summarized descriptively rather than combined into composite predictors in the multivariable regression model. Participants either completed the questionnaire independently or received assistance from the research assistants according to their preference.

For the qualitative component, data collectors conducted in-depth interviews with doctors, nurses, disease control officers, and community health workers directly involved in TB contact investigation, diagnosis and treatment. A semi-structured interview guide was developed for this study by adapting and contextualizing relevant topics and questions from the CDC and the TB CARE I (21, 22). The the interview guide used in the study is provided as additional file 2.

The interviews were conducted in private settings, and information was gathered on provider workload and competing responsibilities, staffing and training, counselling practices, resources and logistics, follow-up, coordination, and organizational and system conditions affecting the contact investigation. These domains were subsequently organized and interpreted using a CFIR-informed implementation framework, which allowed for the emergence of themes not anticipated by the framework.

The data collection instruments were pretested in a health facility outside the study sites with 19 patients who completed the structured questionnaire and four healthcare providers who participated in in-depth interviews.

Pretesting assessed the clarity, relevance, comprehension, and feasibility of the administration. The instruments were refined based on the pretest findings before the main data collection was conducted.

The research team recognized the potential impact of the researchers' academic and public health backgrounds on the data collection and interpretation. Interviewers were mindful of their positionality during the interviews and analysis, and interpretations were shared and discussed within the research team to minimize the potential impact of individual perspectives

Study Variables and Operational Definitions

The primary quantitative outcome was TB contact disclosure, defined as whether a patient reported at least one contact with a healthcare worker for TB contact investigation. Disclosure was analyzed as a binary outcome (yes/no) variable. The number of declared contacts was assessed descriptively and categorized as none, 1–3, or 4 or more contacts.

The questionnaire included items assessing patient awareness of and engagement with contact investigation. Participants were asked whether they knew about TB contact investigation, the source of this information, the number of contacts declared, and the number of household members screened since diagnosis. These were treated as separate contextual variables and not a composite scale. Awareness and information-source items assessed exposure and understanding, while disclosure and household screening items described engagement and outcomes.

The quantitative explanatory variables considered in the inferential analysis were age, sex, marital status, education, occupation, and knowledge of TB contact investigation. Age was categorized for analysis, with participants aged 55 years and above as the reference category in the multivariable analysis.

Knowledge of TB contact investigation was assessed using a seven-item composite measure. Each correct response was assigned a score of 1, while incorrect and "Don't know" responses were assigned 0, producing a total knowledge score ranging from 0 to 7. Consistent with previously applied seven-item health knowledge scoring approaches, scores of 0–3, 4–5, and 6–7 were classified as poor, moderate, and good knowledge, respectively (23, 24). The resulting categorical measure was used in descriptive analyses and to assess its association with contact disclosure.

The qualitative component examined implementation-related factors, including provider workload and competing responsibilities, staffing, counselling practices, logistics and transport, follow-up mechanisms, coordination, training and support, and organizational and system conditions affecting contact investigation.

Data Management and Quality Assurance

Data quality checks were conducted during collection, processing, and analysis. Research assistants were trained for two days on procedures, ethics, interviewing, and quality checks. Quantitative training emphasized consistent questionnaire administration, whereas qualitative collectors were trained in probing, note-taking, and transcription accuracy. Before submitting, supervisors checked the completed quantitative questionnaires. To minimize errors, the quantitative data were entered into IBM SPSS Statistics (SPSS), version 30, using double data entry. With the participants' permission, the interviews were audio recorded and supplemented with field notes, and two researchers independently coded the transcripts and compared the coding for consistency.

Before the analysis, both quantitative and qualitative data were anonymized and stored. The identifiers for the participants were removed, electronic files were secured with passwords, and physical documents were kept in cabinets. Records lacking primary outcomes or regression variables were omitted, and a complete case analysis was conducted.

Quantitative Data Analysis

Quantitative data were analyzed using SPSS version 30. Descriptive statistics were used to summarize the participants' socio-demographic characteristics and patterns of TB contact disclosure. Categorical variables are presented as frequencies and percentages, and continuous variables are summarized using appropriate measures of central tendency and dispersion.

The primary outcome, contact disclosure, was coded as a binary variable: reporting at least one contact versus not reporting any contact. Bivariate associations between contact disclosure and prespecified inferential explanatory variables (age, sex, marital status, education, occupation, and knowledge category) were assessed using the Pearson chi-square (χ^2) test. Variables meeting the prespecified $p < 0.20$ criterion in the bivariable analysis were considered for the multivariable analysis. Age and education were retained in the final multivariable model a priori because of their potential relevance to TB-related disclosure and health-related behavior, regardless of their bivariable screening results. Occupation, despite meeting the $p < 0.20$ criterion, was assessed using Fisher's exact test because of sparse cell counts across categories (Table 4) and was therefore excluded from the multivariable model to avoid unstable coefficient estimates.

A binary logistic regression model was fitted using variables retained from the bivariable analysis to identify factors independently associated with contact disclosure. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported for the analyses. Age was entered as a categorical variable, with participants aged 55 years or older as the reference category. Education was entered as an ordinal variable reflecting the ordered categories of educational attainment. The corresponding adjusted odds ratio was interpreted as the change in odds of contact disclosure associated with a one-category increase in educational attainment. This specification assumes a linear trend in the odds across successive education categories. No interaction terms were included; therefore, age was interpreted as a predictor, rather than a statistical moderator. Model adequacy was assessed using the Nagelkerke R^2 and Hosmer–Lemeshow goodness-of-fit tests. Statistical significance was set at $p < 0.05$.

Qualitative Data Analysis

The transcripts were imported into ATLAS.ti version 23.0.6 to perform coding and organization, followed by a combination of deductive and inductive analysis for data analysis. Deductive coding was based on the study objectives and the CFIR framework. Attention was given to providers and organizational barriers in relation to health system capacity, workload, logistical challenges, stigma, and confidentiality issues, coordination, and follow-up, and other factors in TB contact investigation (15, 16). Inductive coding was used to identify trends in the participants' accounts that were not covered in the formal coding.

The codes were first reviewed, compared, and grouped into broader categories and themes (Table 7). The codes were interpreted in terms of narrative and context. Coding discrepancies were discussed and resolved, and related codes were organized using ATLAS.ti's coding and visualization functions.

Mixed-Methods Integration and Consolidated Framework for Implementation Research Application

Quantitative and qualitative components were separately analyzed and merged into the interpretation process in a convergent manner. Quantitative findings showed patterns and statistical associations of patient contact disclosure, whereas qualitative findings provided a provider-, organizational-, and system-level context for implementation-level factors. The two sides were compared to identify similarities and differences in the findings, and CFIR was used to help interpret the impact on implementation determinants, as in previous studies (25–27). CFIR was the framework for organizing and understanding the qualitative findings and their relationship to the quantitative results (16). Providers and organizational findings were mapped to the relevant CFIR domains and constructs, and patient-level findings were used as evidence of contact investigation engagement. The analysis retained an empirical thematic pattern in line with the CFIR. Integration was used to examine how patient engagement concerns and provider, organizational, and contextual conditions were related to the implementation of TB contact investigation (25–27)

RESULTS

Patient Participant Characteristics

As presented in Table 1, a total of 212 patients with PTB responded to the questionnaires. Of these, 126 (59.4%) were male and 86 (40.6%) were female. Participants were divided into five age groups, and those aged ≥ 55 years were the largest (26.4%), followed by 45–54 years (25.0%). Most of the participants were married (39.2%) and 34.9% were single. Nearly half of the participants (46.2%) were self-employed. At the time of the survey, 30.7% of the participants had been receiving TB treatment for 1–3 months, and 23.1% had been taking treatment for less than one month.

Table 1
Characteristics of patients with pulmonary tuberculosis participating in the study

Characteristic	Category	n	%
Sex	Male	126	59.4
	Female	86	40.6
Age group (years)	18–24	31	14.6
	25–34	33	15.6
	35–44	39	18.4
	45–54	53	25.0
	≥ 55	56	26.4
Marital status	Single	74	34.9
	Married	83	39.2
	Divorced	20	09.4
	Widowed	35	16.5
Educational level	No formal education	34	16.0
	Primary	38	17.9
	Junior High School	44	20.8
	Senior High School	45	21.2
	Tertiary	51	24.1
Occupation	Self-employed	98	46.2
	Unemployed	32	15.1
	Formal employment	82	38.7
Duration on TB treatment	< 1 month	49	23.1
	1–3 months	65	30.7
	4–6 months	52	24.5
	> 6 months	46	21.7

Healthcare-Provider Participant Characteristics

Twenty-five healthcare providers were recruited for the qualitative component across six health facilities in the Kumasi Metropolis, Asokwa Municipal, and Bosomtwe Districts. Eight participants (32.0%) were from Kumasi Metropolis, eight (32.0%) from Asokwa Municipal, and nine (36.0%) from Bosomtwe District. Participants worked in district (52.0%), regional (20.0%), religious (16.0%), and private hospitals (12.0%). Cadres comprised nurses (28.0%), disease control officers (28.0%), community health workers (24.0%), and medical officers (20.0%) illustrated in Table 2. TB-care experience and primary positions in TB-related work had diverse roles, which ranged from clinical, disease control, community, data management, and patient engagement activities.

Table 2
Characteristics of Healthcare provider participants in the qualitative component

Characteristic	Category	n	%
District	Kumasi Metropolis	8	32.0
	Asokwa Municipal	8	32.0
	Bosomtwe District	9	36.0
Facility type	District hospital	13	52.0
	Private hospital	3	12.0
	Regional hospital	5	20.0
	Religious hospital	4	16.0
Professional cadre	Medical Officer	5	20.0
	Nurse	7	28.0
	Disease Control Officer	7	28.0
	Community Health Worker	6	24.0
Years of experience in TB care	1–3 years	8	32.0
	4–6 years	10	40.0
	7 years or more	7	28.0
Primary role in TB contact investigation	Diagnosis and Treatment Supervision	5	20.0
	Data Management and Reporting	5	20.0
	Contact investigation and Field Follow-up	10	40.0
	Patient Counselling and Health Education	5	20.0

Patient and Interpersonal Determinants of Contact Disclosure

Awareness, Knowledge and Contact Disclosure

Most participants (82.5%, n = 175) were aware of the TB contact investigation (Table 3). Among those who were informed, healthcare workers were the primary source of information (87.4%, n = 153). Overall, 118 participants (55.7%) reported at least one contact, whereas 94 (44.3%) did not report any contact. Of the 212 participants, 58.0% had good, 33.0% had moderate, and 9.0% had poor knowledge.

Disclosure

proportions varied across knowledge categories; however, knowledge level was not significantly associated with contact disclosure (^{2} = 2.717, df = 2, p = 0.257).

Table 3
Awareness and knowledge of tuberculosis contact investigation in relation to contact disclosure

Variable	Category	n (%)	Disclosure: Yes, n (%)	Disclosure: No, n (%)
Awareness	Heard about contact investigation	175 (82.5)	—	—
	Not heard	37 (17.5)	—	—
	Health worker	153 (87.4)	—	—
Source among aware (n = 175)	Friend/family	12 (6.9)	—	—
	Media/other	10 (5.7)		
Contact disclosure	Disclosed at least one contact	118 (55.7)	—	—
	Did not disclosed any contact	94 (44.3)	—	—
	Poor knowledge	18 (9.0)	13 (72.2)	5 (27.8)
Knowledge level	Moderate knowledge	71 (33.0)	36 (50.7)	35 (49.3)
	Good knowledge	123 (58.0)	69 (56.1)	54 (43.9)

Sociodemographic Factors Associated with Contact Disclosure

In the bivariable analysis, age category was significantly associated with contact disclosure ($\chi^2 = 9.685$, $p = 0.046$). Sex ($p = 0.750$), marital status ($p = 0.455$), education ($p = 0.315$), and occupation ($p = 0.065$) were not significantly associated with contact disclosure in the bivariable analysis.

Table 4
Bivariable associations between patient characteristics and tuberculosis contact disclosure

Patient characteristic	χ^2	df	p-value
Age category	9.685	4	0.046
Sex	0.102	1	0.750
Marital status	2.613	3	0.455
Education level	4.740	4	0.315
Occupation	—	—	0.065

Stigma, Confidentiality and Anticipated Social Repercussions

There was evidence of interpersonal concerns among the patients. Forty-six percent of respondents reported concerns about family privacy, 43.9% reported fear of blame, 40.1% reported fear of being judged during TB treatment, and 38.2% were concerned that their contacts might experience stigma if screened. Disclosure proportions varied descriptively across these reported concerns. For family privacy concerns, 50.0% of those who

reported the concern disclosed contacts compared with 59.7% among those who did not report the concern. Similarly, 52.7% of participants who reported fear of blame disclosed their contacts compared with 58.0% among those who did not report the concern. Among those concerned that contacts might experience stigma if screened, 49.4% disclosed contacts compared with 63.0% among those who did not report the concern. Among participants who reported fear of being judged during TB treatment, 25.9% disclosed their contacts compared with 66.7% among those who did not report the concern (Table 5).

Table 5
Patient-reported stigma, fear and confidentiality concerns in relation to tuberculosis contact disclosure

Patient-reported concern	Agree/ Strongly agree, n (%)	Neutral, n (%)	Disagree/Strongly disagree, n (%)	Disclosure among agree/Strongly agree	Disclosure among disagree/Strongly disagree
Fear of blame prevented listing contacts	93 (43.9)	38 (17.9)	81 (38.2)	49/93 (52.7%)	47/81 (58.0%)
Family privacy concerns	98 (46.2)	37 (17.5)	77 (36.3)	49/98 (50.0%)	46/77 (59.7%)
Contacts feared stigma if screened	81 (38.2)	50 (23.6)	81 (38.2)	40/81 (49.4%)	51/81 (63.0%)
Fear of being judged during TB treatment	85 (40.1)	52 (24.5)	75 (35.4)	22/85 (25.9%)	50/75 (66.7%)

Disclosure

proportions across response categories are presented descriptively; no inferential statistical tests were performed for these individual items

Multivariable Logistic Regression Analysis of Contact Disclosure

In the multivariable logistic regression model (Table 6), age category was the only demographic factor that was independently associated with disclosure. Using participants aged ≥ 55 years as the reference group, participants aged 25–34 years had higher odds of disclosing contacts (AOR = 2.64, 95% CI: 1.06–6.54; p = 0.036), while those aged 45–54 years had more than three-fold the odds of disclosure (AOR = 3.18, 95% CI: 1.42–7.13; p = 0.005). The associations for participants aged 18–24 and 35–44 years were not significant. Education level was also not significantly associated with contact disclosure (AOR = 0.85, 95% CI: 0.70–1.04, p = 0.111).

The model showed no evidence of poor fit according to the Hosmer–Lemeshow test ($\chi^2(8) = 6.69$, p = 0.571). The Nagelkerke R^2 was 0.087, and the overall classification accuracy was 59.0%.

Table 6
Multivariable logistic regression analysis of factors associated with tuberculosis contact disclosure

Predictor	AOR	95% CI	p-value
Age group (years)			
≥ 55	Reference	—	—
18–24	1.67	0.65–4.26	0.284
25–34	2.64	1.06–6.54	0.036
35–44	2.01	0.84–4.81	0.115
45–54	3.18	1.42–7.13	0.005
Education level (per category increase)	0.85	0.70–1.04	0.111
Model fit statistics: Hosmer–Lemeshow $\chi^2(8) = 6.69$, $p = 0.571$; Nagelkerke $R^2 = 0.087$; overall classification accuracy = 59.0%			

Provider- and Organizational-Level Barriers to Contact Investigation Implementation

Table 7
Themes and subthemes that emerged from healthcare-provider interviews on tuberculosis contact investigation

Theme	Subthemes
Provider workload and competing responsibilities	• High patient workload • Competing program and clinical responsibilities • Diagnostic workload and bottlenecks
Logistics, transport and geographic constraints	• Limited transport and fuel availability • Rural distance and poor road conditions • Sample-transport and diagnostic-result delays
Counselling and patient engagement	• Counselling to promote understanding and participation • Fear limiting disclosure despite counselling • Limited time for in-depth counselling • Confidentiality concerns limiting engagement
Human resources and coordination	• Limited dedicated TB personnel • Inter-facility coordination gaps • Sample-transfer coordination
Data management and DHIMS2 operational challenges	• Network connectivity and data-reconciliation difficulties • System downtime and reliance on paper-register backup • Concentration of data-entry responsibilities among few staff

Provider Workload and Competing Responsibilities

Healthcare providers described workload pressures as a major constraint in tuberculosis contact investigations. High patient volumes, multiple clinical and public health responsibilities, and concurrent administrative duties reduce the time available for household follow-up. Providers described managing TB activities alongside outpatient care, malaria, the Expanded Program on Immunization (EPI), contact investigation, and data entry. One participant summarized the burden as follows: *"The main problem was patient overload. Sometimes we have more than we can manage in a day, and this delays follow-ups"* (IDI-02).

The workload was extended across multiple programmatic responsibilities. A community health worker explained that combining TB, malaria, and EPI activities made timely follow-up difficult: *"I have to combine TB, malaria, and EPI activities. By the time I return from outreach, it's difficult to follow up all TB contacts the same week"* (IDI-18). Similarly, a nurse described the simultaneous demands of clinical, follow-up, and data-entry duties: *"You are doing OPD, contact tracing and data entry… it is too much for one person"* (IDI-21).

Providers also identified the diagnostic workload as a constraint on timely follow-up. High sample volumes and limited GeneXpert processing capacity have been reported to slow down diagnostic processes and subsequently delay contact investigation activities. As one provider noted, *"Sometimes we receive a large volume of samples a day, and the GeneXpert machine can only process a few at a time. It slows everything down, including follow-ups"* (IDI-01).

Logistics, Transport and Geographic Constraints

Providers reported that transport and logistical challenges have hampered tuberculosis contact investigations, particularly in household and community follow-ups. Limited access to vehicles and fuel at healthcare facilities restricted field outreach and delayed household investigations. One provider noted, *"When there is no fuel, the tracing delays. Sometimes we just call the person instead of going"* (IDI-25).

Geographic access compounded these constraints. Providers referred to long distances to rural communities and poor road conditions, most notably in the rainy season, which made household follow-up difficult. As one nurse explained, *"Many contacts live in rural communities, and sometimes we don't have fuel or a vehicle available. It becomes difficult to follow up, especially when roads are bad during the rainy season"* (IDI-21).

Delays in sample transportation and the receipt of diagnostic results also affected the timing of contact-investigation activities. A provider reported that samples could take two to three days to generate results, delaying the initiation of contact investigation when confirmation of the index case was required: *"Transporting samples is a big issue. Sometimes we wait two to three days for results, and patients become frustrated… delays can affect contact tracing because we can't start until diagnosis is confirmed"* (IDI-06).

Counselling Practices and Patient Engagement

Counselling is an important component of tuberculosis contact investigation. Healthcare providers reported counselling patients and families about tuberculosis, contact screening, treatment, and confidentiality. One provider described efforts to reassure patients about treatment and confidentiality: *"We take time to counsel them and assure them that TB is curable and confidentiality is maintained"* (IDI-03). But counselling was not always enough to settle patients' concerns. As providers alluded to fear and confidentiality concerns, patients were not willing to provide contact information. One participant noted, *"I also help counsel patients…, but sometimes they are not willing to share information because of fear"* (IDI-09).

Human Resources and Coordination Challenges

Healthcare providers also described limited staff and coordination issues as additional hindrances to tuberculosis contact investigation. With few designated TB control staff, contact investigation activities were often added to existing duties, which reduced the rate of follow-up. "*More staff dedicated solely to TB activities would help…"*(IDI-17) one provider said. Communication challenges between health facilities and referral centers, especially with the transfer of samples and confirming diagnostic results, also came up. One participant commented, "…we *sometimes have to call repeatedly to confirm if results are ready….*" (IDI-06) and that a designated courier structure could improve sample transfer: "*Having a [designated] staff as a courier system for samples would help"* (IDI-06).

Data Management and DHIMS2 Operational Challenges

Healthcare providers reported operational challenges in managing tuberculosis data, particularly poor network connectivity, system downtime, and delays in electronic data entry. Providers described periodic reconciliation of facility registers with DHIMS2 records to identify and resolve any discrepancies. One participant explained, *"Sometimes we have differences between our registers and what appears in DHIMS2. We check and reconcile data monthly, but when the internet is poor, uploading becomes difficult"* (IDI-16). Another participant noted, *"System downtime delays entries, but we keep facility register records as backup"* (IDI-24).

Data entry responsibilities were also concentrated among a few staff members who managed multiple programs, increasing workload and possibly causing delays in data entry.

Integrated Mixed-Methods Findings

Convergence of Patient and Provider Evidence on Stigma and Confidentiality

Qualitative and quantitative findings commonly reported stigma, confidentiality concerns, and anticipated social consequences as important barriers to disclosure (Table 8). Among patients, family privacy concerns and fear of blame were frequently reported. Healthcare providers similarly described patients withholding contact information because of concerns about gossip, discrimination, and unintended disclosure of their TB status.

Table 8
Convergence of quantitative and qualitative evidence on stigma, confidentiality and contact disclosure

Barrier	Quantitative evidence	Qualitative evidence	Integrated finding
Family privacy concerns	46.2% of the participants A total of 46.2% agreed/strongly agreed that contact screening could expose family privacy.	Providers reported concerns that family members or neighbors might learn about patients' TB status.	Unintended disclosure represented an interpersonal barrier to contact disclosure.
Fear of blame	43.9% agreed/strongly agreed that fear of blame prevented them from listing contacts.	Providers described withholding of contact names because of gossip, discrimination, and social judgment.	Anticipated negative social consequences discouraged participants from disclosure.
Anticipated stigma	A total of 38.2% reported that they were concerned that contacts might fear stigma if screened.	Providers reported that stigma could discourage contacts from participating in testing.	Stigma affected both the willingness to disclose and anticipated participation.
Fear of judgment	40.1% of the participants A total of 40.1% reported fear of being judged during TB treatment.	Providers described social image and community perceptions as influencing their willingness to disclose.	Social judgment represented a broader interpersonal context that influenced engagement.

Complementarity of Organizational Constraints and Patient Engagement

The qualitative findings of the qualitative study complemented the quantitative results on patient engagement. The providers described workload, competing responsibilities, and limited time for counselling and follow-up, while the quantitative evidence showed that disclosure was not universal, even with high awareness of contact investigation. Patients also reported privacy and blame-related concerns (Table 9).

Table 9
Integrated quantitative and qualitative findings on patient engagement and organizational capacity

Integrated issue	Quantitative evidence	Qualitative evidence	Relationship between findings
Incomplete patient engagement and organizational capacity	Although 82.5% of patients had heard of TB contact investigation, 55.7% disclosed at least one contact, and 44.3% disclosed none	Providers described high patient volumes, competing program responsibilities, and limited time for contact follow-up and counselling	Complementarity: The qualitative findings provided contextual evidence on organizational conditions occurring alongside the incomplete patient engagement observed quantitatively
Interpersonal concerns and counselling capacity	Family privacy concerns were reported by 46.2% of patients and fear of blame by 43.9%	Providers reported that limited time for counselling and follow-up could constrain opportunities to address patients' concerns about privacy, fear, and disclosure	Complementarity: Patient-reported interpersonal concerns occurred alongside provider-reported constraints on the time available to address such concerns through counselling

Age-Related Differences in Contact Disclosure

Age was the only demographic factor independently associated with contact disclosure in the adjusted model. Participants aged 25–34 and 45–54 years had higher odds of reporting contact disclosure than those aged ≥ 55 years. No difference in disclosure was found for 18–24- and 35–44-year-olds compared with the reference group

aged ≥ 55 years. Healthcare provider accounts provided contextual information on differences in their willingness to discuss illness and contact with their patients. Some providers described perceived differences in patients' willingness to discuss illness and contact information, although these accounts did not establish the mechanisms underlying the observed age association. The study showed that barriers to tuberculosis contact-investigation implementation were at multiple levels. On the one hand, age was associated with disclosure, while knowledge was not significantly associated with disclosure despite high levels of awareness of contact investigation

DISCUSSION

Principal Findings

This study examined barriers to TB contact investigation implementation in health facilities in Ghana's Ashanti Region, focusing on patient disclosure of contacts and the organizational conditions for delivery. Patient contact disclosure was not universal despite high awareness of TB contact investigation, and knowledge was not significantly associated with disclosure. At the interpersonal level, privacy, stigma, blame, and social consequences impacted engagement, whereas provider accounts indicated workload, limited counselling time, transportation, geographic constraints, staffing limitations, and coordination challenges

Interpersonal Barriers: Privacy, Stigma and Anticipated Social Consequences

The findings indicated that disclosure occurred in a context in which privacy concerns, fear of blame, judgment, and anticipated social consequences were frequently reported. The integrated patient and provider accounts suggested that, in addition to knowledge of contact investigation, patients may also consider the possible implications of contact disclosure for family relationships, social status, and confidentiality. These findings highlight the interpersonal and social context in which contact-investigation processes occur and relate to CFIR concepts around individual perceptions. Patient-centered counselling should therefore address not only the rationale and benefits of contact investigation but also patients' concerns about contact disclosure, potential social and familial consequences, and confidentiality

These findings are compatible with the evidence that confidentiality is central to contact investigation in tuberculosis because index patients and their contacts are socially interdependent (28). Likewise, guidance on contact investigation calls for upholding confidentiality, addressing patients' concerns, and avoiding coercion when patients are unwilling to disclose contacts (29). Evidence from Ghana has demonstrated that TB-related stigma and fears of disclosure can deter patients from identifying contacts (6), whereas evidence from Uganda has shown that behavior and communication-related factors can promote engagement in contact investigation (30).

WHO provided a guidance on the need to proactively assure confidentiality and to have discussions with patients about how investigations will be conducted and how their privacy will be protected (31). This issue requires attention, given that contact investigations occur beyond the clinical setting and involve households, workplaces, and communities. Therefore, patients' TB status has the potential to become public in venues where they do not have control. Patient engagement, thus, needs to assure trust, educate patients about the nature and process of contact investigation, and offer clear confidentiality safeguards.

Knowledge, Awareness and Contact Disclosure

The absence of a statistically significant association between knowledge and contact disclosure suggested that increasing knowledge alone may not be sufficient to achieve disclosure of contacts. While knowledge is empowering and enables patients' understanding of the rationale and procedures of contact investigation, disclosure is a behavioral choice that may hinge on factors that transcend knowledge.

Providers cited patient reluctance, despite counselling, an indication that sharing information does not necessarily allay decision-making concerns. That is, the convergence of these findings suggests that information-education activities should be considered a necessary but insufficient element of an implementation strategy. The role of provider-initiated patient education as an entry point to contact investigation is needed, but its efficacy is conditional on the extent to which counselling also addresses the interpersonal barriers elucidated by this study.

Age and Contact Disclosure

The independent association between age and contact disclosure is broadly consistent with evidence from Ghana and other sub-Saharan African settings, which shows that age is associated with attitudes or intentions surrounding TB disclosure. In a Ghanaian national analysis, willingness to keep TB status secret generally declined with increasing age, suggesting more favorable disclosure attitudes among older respondents (32). Similarly, a multicounty analysis in sub-Saharan Africa identified age as one of several social determinants associated with intentions to conceal TB status (33)

However, attitudes and intentions to conceal TB status are distinct from the actual behavior of disclosure of contact, and the observation in the present study that age was independently associated with disclosure, indicates that age effects may vary depending on the outcome measure and social and health system context. Within the CFIR framework, age can be considered as a characteristic associated with engagement in contact investigation. However, the mechanisms underlying this association, such as autonomy, household roles, social expectations, and perceived consequences of disclosure, need further investigation.

Organizational Capacity, Workload and Logistics

Healthcare providers described high patient volumes, competing program responsibilities, limited time for household follow-up, diagnostic bottlenecks, transport and fuel shortages, difficult rural access, poor roads, and delays in sample transportation and receipt of results. Limited dedicated TB staffing and coordination difficulties were additional constraints.

These findings are important because contact investigation requires activities that extend beyond routine facility-based care. When healthcare providers are simultaneously responsible for multiple programs and clinical duties, the time and logistical capacity available for household follow-up, and counselling may become constrained (8). Similar constraints involving household follow-up, transport, and implementation workload have been reported in other contact-investigation settings (7, 11). Evidence from a broader systematic review likewise identifies workload and health-system capacity as recurring barriers to TB interventions (12).

In this study, inadequate time, transport, and dedicated personnel were not isolated operational inconveniences; they formed part of the context within which contact investigation had to be delivered. This is consistent with the CFIR emphasis on implementation determinants related to available resources and implementation processes (16), as well as evidence from rural TB contact-investigation settings (8).

Similar issues concerning transport and access have been raised in household-based TB contact investigations (2, 7, 11). As such, an implementation strategy that considers routine availability of transport may have different outcomes in different facilities, based on geography and infrastructure. This indicates that the operational requirements of community-based contact investigations should be taken into account in the allocation of responsibility and resource allocation.

Counselling as the Patient–Provider Implementation Interface

Counselling is an important link between interpersonal and organizational findings. Providers described counselling patients and families about TB, contact screening and confidentiality but also said that some patients were unwilling to provide contact information because of fear or concern about disclosure. At the same time, a heavy workload and competing responsibilities limited time for detailed counselling and follow-up.

Counselling was more than information delivery; it was where providers built trust with patients, addressed their concerns and enabled genuine voluntary participation in contact investigations. However, the qualitative findings suggested that if providers had limited time because of competing responsibilities there might be fewer opportunities to explore privacy and stigma concerns in detail. Counselling stresses communication, privacy and patient-centered approaches during contact investigation (34) and behavioral evidence suggests that trust and interpersonal concerns can affect participation (30).

This indicates that implementation was shaped by interacting patient interpersonal and organizational conditions but not a single determinant. In the CFIR framework, counselling can be understood as part of the implementation process of engaging patients with the intervention and carrying out contact-investigation activities. Its effectiveness also depends on the conditions under which providers perform this role (16). These cross-sectional interpretive findings are contextual patterns not causal pathways.

Implications for Implementation

The study results indicated that improving TB contact investigations will require interventions at the patient level as well as the system in which the investigation occurs. Patient-level interventions should involve counselling regarding confidentiality and concerns about stigma, blame, and disclosure. At the system level, successful investigation requires adequate staffing, including allocation of sufficient time, personnel, and transportation resources to allow for appropriate household investigations, particularly when providers have competing demands or serve patients in geographically dispersed areas. These system-level factors should be considered in the overall TB program design, rather than as stand-alone interventions at the patient or provider level.

Strengths and Limitations

Convergent mixed methods design allowed for the quantitative assessment of factors related to contact disclosure and healthcare providers' views on implementation barriers. Having both patient and provider perspectives enabled us to examine the issue from individual, interpersonal, and organizational levels. The CFIR informed interpretation provided an implementation science perspective and allowed these complementary findings to be integrated into the literature.

On limitations, the quantitative component was cross-sectional; therefore, the observed association between age and contact disclosure cannot be causally interpreted, and contact disclosure was self-reported, which may have

been biased by recall or social desirability. The qualitative component came from healthcare provider perspectives; therefore, it does not directly reflect patients' experiences; although patient-reported privacy, blame, and stigma were quantified, they were not established as independent predictors of disclosure. Again, the study was carried out in selected facilities in the Ashanti Region, which may limit transferability to other settings in Ghana. The multivariable model had limited explanatory power (Nagelkerke $R^2 = 0.087$), indicating that the predictors included in the model explained only a limited proportion of the variation in contact disclosure. Finally, the qualitative findings contextualized the quantitative findings but did not establish causal mechanisms, such as mechanisms underlying age differences in disclosure

CONCLUSION

The implementation of tuberculosis contact investigation in the studied setting occurred within a context characterized by interpersonal and organizational factors. The factors to consider include the patient's fears of exposure to stigma, privacy, blame, and social consequences. On the provider's side, the factors were the provider's work time, competing priorities, workload, organizational barriers, and logistical constraints. Therefore, TB contact investigation is a multilevel implementation challenge that requires patient engagement sensitive to confidentiality, alongside adequate staffing, protected time, and logistical support.

Abbreviations

AOR	Adjusted Odds Ratio
CFIR	Consolidated Framework for Implementation Research
CI	Confidence Interval
DHIMS2	District Health Information Management System 2
DOI	Digital Object Identifier
EPI	Expanded Program on Immunization
ERC	Ethics Review Committee
GHS	Ghana Health Service
IBM	International Business Machines
IDI	In-depth Interview
OPD	Outpatient Department
PTB	Pulmonary Tuberculosis
SPSS	Statistical Package for the Social Sciences
TB	Tuberculosis
WHO	World Health Organization

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the declaration of Helsinki. Ethical approval was obtained from the Ghana Health Service Ethics Review Committee (GHS-ERC:062/05/25). Institutional approval was obtained from the Kumasi Metropolis, Asokwa Municipal, and Bosomtwe District Health Directorates, and the respective authorities of the six participating healthcare facilities. Written informed consent was obtained from all participants before data collection, and confidentiality was maintained throughout the study.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed in the current study are available from the corresponding author on reasonable request

Competing interests

The authors declare no competing interests.

Funding

This study received no external funding

Authors' contributions

AK conceived the study, developed the research concept, conducted the data analysis, and drafted the manuscript. IAK was part of the study conceptualization and refinement. IAK supervised the work and provided editorial guidance throughout the research and manuscript development processes. MOM provided editorial guidance throughout the research, manuscript development, reference validation, and formatting processes. All authors read and approved the final manuscript

Acknowledgements

The authors sincerely acknowledge the contribution of all participants who contributed to the data used in this study

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