Facilitators and Barriers to Implementation of Childhood Tuberculosis Control Program in Bangladesh: a Mixed-methods Study From BRAC Urban DOTS Centres in Dhaka

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Abstract

Background

World Health Organisation (WHO) estimates childhood tuberculosis (tb) in high burden countries to be at least 10-15% of all cases. Despite intensive efforts on the childhood tb control program in Bangladesh, case detection rates stand below 5%. This study investigated the implementation pathway of childhood tb in Bangladesh. The study aims to identify the factors that enable and hinder the diagnosis and treatment of childhood tb in Bangladesh.

Methods

An exploratory-explanatory mixed-methods study was carried out in eight (top four and bottom four based on new case identification) urban DOTS (Directly Observed Treatment, Short-course) centres of the BRAC tb program in Dhaka Metropolitan City, Bangladesh. The study was conducted between September and December 2017. The knowledge, attitude, and practice (KAP) assessment on diagnosis and treatment of childhood tb were conducted among 111 *Shasthya Shebika (SS)*, frontline health care workers engaged in the tb program. Field workers (n=32) and mothers of tb patients (n=4) participated in In-Depth Interviews. Key Informant Interviews (n=9) were conducted with program managers of BRAC and other key stakeholders involved in implementing the tuberculosis program in Bangladesh.

Results

The survey showed a low level of knowledge on routes of transmission. The knowledge score was significantly associated with the recall of the components of training (p=0.02). Government stewardship, the presence of specific guidelines, capacity building of health workers, knowledge of frontline health workers were identified as key facilitators for the diagnosis and treatment of childhood tuberculosis. Major constraints identified included the presence of stigma, delays in seeking care, lack of diagnostic facilities, and poor engagement of private practitioners in the national tuberculosis program.

Conclusion

A triad of strategies including capacity building of frontline health care workers, use of recent technological advances in diagnosis, and continuous monitoring of the suspected or identified cases in the field have resulted in increased case notification of childhood tb in Bangladesh over the past few years. Frequent turnover and change of key positions in National Tuberculosis Program (NTP) and absenteeism of paediatricians in government hospitals were important barriers to implementation of childhood tb program.

Contributions To The Literature

- The frontline health workers are adequately trained to identify children with symptoms of tuberculosis.

- Close monitoring and supervision of treatment at the patient's home contributed to higher compliance with treatment.
- The use of the Gene-Xpert machine attributed to an increased case identification of childhood tb. The Gene-Xpert facility should be made available at the district level to improve case detection.
- Interventions need to focus on reducing delays in the diagnosis and treatment of childhood tuberculosis.
- Future implementation strategy should focus on activities on reducing social stigma and creating community awareness on childhood tuberculosis.

Background

The World Health Organisation (WHO) suggested the implementation of various strategies to improve case detection of childhood tuberculosis (tb), including a specific guideline for clinical diagnosis and treatment of childhood tb [1, 2]. It has been estimated that in a country with a high tb prevalence, children should contribute to about 10%-15% of total tb cases [3-5]. In contrast, the number of identified childhood tb cases in these high burden countries is far below the expected numbers [6]. For example, below five percent of total tb cases were attributed to children (2.1% in 2014 and 3.8% in 2015) in Bangladesh [7, 8]. Bangladesh, globally known for its successful implementation of an innovative tuberculosis control program, is struggling with case identification of childhood tb [9, 10].

There could be potential challenges to improvise the diagnosis and treatment of childhood tb. Lack of adequate knowledge and awareness among frontline health care may be one of the important factors that delay the identification of active cases. In a study, Bjerrum et. al interviewed 29 frontline health care workers in rural Tanzania to understand the perceptions of childhood tb [11]. The authors report that none of the health care workers, interviewed in the study recognized childhood tb as an emerging problem. Besides, relying on the conventional diagnostic criteria (positive sputum microscopy in a patient with constitutional symptoms of tuberculosis- fever, cough >2 weeks, and weight loss) may lead to missed opportunities as sputum production is difficult in children, particularly in those below five years of age [12, 13]. Besides, the low sensitivity of the diagnostic criteria, financial constraints, and lack of modern laboratory tests (GeneXpert and x-rays) may contribute to delay in early diagnosis of the suspected cases [5, 13-16]. Additionally, lack of child-friendly drugs [15, 17], inadequate supply [13], and difficulty in administrating medicines [18] can lead to poor treatment adherence. Further, tb is often not suspected in a sick child due to the preconception that BCG (Bacillus Calmette-Guerin) vaccination protects children from tuberculosis [12, 13]. Therefore, to overcome these diagnostic difficulties, it is important to explore the existing implementation and find out what are the good attributes and what needs to be improved or modified.

The tuberculosis control program in Bangladesh is operationalized by the government of Bangladesh in partnership with two partner organisations – BRAC and Damien Foundation [7, 8]. To focus on childhood tb, the government has initiated separate guidelines for childhood tuberculosis in 2012 [19]. But the

number of cases identified is not satisfactory. So far, no study has investigated the implementation pathway to evaluate the factors influencing low case identification for childhood tb cases in Bangladesh. The study aimed to explore the implementation pathway for the diagnosis and treatment of childhood tb control program in Bangladesh based on the three strategic pillars (1. patient-centric care, 2. bold policies and supportive systems, and 3. intensified research and innovation) of “the End TB Strategy” (introduced in 2015 with a vision of zero avoidable deaths, disease, and sufferings from tb) [20].

Methodology

Study design and settings:

A concurrent triangulation design with the convergent model, a variant of the mixed-method approach was used. In a concurrent design, both quantitative and qualitative data are collected simultaneously, analysed separately and the results are triangulated with each other [21]. Using a mixed-methods approach enhances the strength of the study [21, 22].

The study was carried out in the BRAC urban DOTS centres in Dhaka Metropolitan city, between September 2017-January 2018. There are 24 Urban DOTS centres under Dhaka City Corporation (both North and South City Corporation) each with a catchment area of about 100,000 population. The number of new cases of childhood tb between January 2016-July 2017 was obtained from the monitoring and evaluation division of the BRAC tb program. Eight centres (four each with the highest and lowest number of the new cases) were selected as the study sites. The study was purposefully conducted in centres with high and low case notification to identify if any factors influenced the difference in case notification. The field-level data, both quantitative and qualitative, were collected from these centres. The policy level data was obtained from key stakeholders involved in planning, implementation, monitoring, and evaluation of the childhood tb program in Bangladesh.

Figure 1 shows the detailed information about the study population, the number of respondents, and the objectives addressed by different components of the study (insert figure 1 here).

1. **Quantitative component:**

Study population

We surveyed the frontline healthcare workers (*Shasthya Shebika – (SS*)) to investigate the knowledge, attitude, and practices on diagnosis and treatment of childhood tb. The SS are frontline voluntary workers in the BRAC program who provide door to door services in the community. They identify suspected patients based on their history of symptoms (cough for more than two weeks and fever), bring or encourage potential patients to visit the DOTS centre for sputum examination, and provide treatment after diagnosis. They receive basic and periodic refresher training to upgrade their knowledge [23].

Sample size

We assumed about 50% of the SS have adequate knowledge of childhood tb. With 90% power, 10% margin of error, and 20% non-participation rate, the required number of sample size was 116. We calculated the proportionate number of SS from each of these eight DOTS centres. The SS were purposefully selected based on two criteria- 1. lives within a radius of 5 kilometers from the DOTS centre and 2. not engaged in providing treatment to a case of childhood tb in the past 12 months.

Survey process:

The program organizers are the primary supervisor of BRAC SS. We contacted the program organizer at each of the selected DOTS centres to identify the suitable date and time for data collection. All eligible SS were identified and requested by the respective program organizer to be present at the DOTS centre for participating in the study.

2. **Qualitative component:**

We conducted Key Informant Interview (KII) among senior officials engaged in the implementation of the tb control program and In-Depth-Interview (IDI) with health care workers and mothers of children with active tuberculosis (the number of participants is given in figure 1). In IDIs, we explored the issues with the implementation of childhood tb at field level and consumer experiences of service uptake. In KIIs, we investigated the implementation pathway, strategic components, and initiatives taken for case detection and management of childhood tb. Health workers who were working in the current capacity for at least six months before data collection were included for the IDIs.

Study tool and data collection process

A structured questionnaire was prepared for the survey. We followed the guidelines recommended by the WHO for developing KAP surveys [24]. We adopted the questionnaire used by Noe et. al, to investigate the KAP on tb care among health workers in Southern Mozambique [25]. We added KAP questions specific to childhood tb with input from previous KAP studies on childhood tb conducted in Bangladesh [13], Philippines [26], and South Africa [27]. The questionnaire was translated in Bangla and pretested among 25 SS in a Dhaka Urban DOTS centre which was not a site for study data collection. An English version of the questionnaire used for the study is available as a supplementary material (Additional file 1).

The in-depth interviews (IDI) and key-informant interviews (KII) were conducted using semi-structured guidelines. The IDI and KII guidelines were translated into the Bangla language. IDI guidelines was also pre-tested in the same DOTS centre.

Input from the pretest was discussed among the team members and incorporated into the final study tools.

Four data enumerators were recruited and trained on study objectives and data collection techniques. The survey questionnaire was administered by the enumerators under the direct supervision of the

researchers. The IDI's and KII's were jointly conducted by the primary researchers (SP, SC, SMH, UD, and MJA).

Quantitative data analysis

Data were entered in the Microsoft Excel sheet, cleaned, and then analysed in Stata 13.0. Descriptive analysis was carried out using frequency and percentage. Every KAP component, each correct and incorrect answer was scored '1' and '0' respectively. The total scores on each domain of knowledge, attitude, and practices were calculated and categorized as "Poor", "Average" and "Good" with a 33 percent and 67 percent (of the maximum score) as the cut-off value. Bivariate analysis was done to identify an association between the KAP scores and demographic characteristics of the respondents that included age, level of education, duration of work, duration of treating a child with tuberculosis, the performance of the DOTS centre and the number of patients treated within past 12 months using Chi-square and Fisher Exact test as applicable.

Qualitative data analysis

The IDIs and KIIs conducted in Bangla were transcribed and translated simultaneously in English whereas those conducted in English were transcribed verbatim. The translation was done by the data enumerators and verified by Bengali speaking members of the research team (SP, SMH, and SC). Four A-priori themes were identified – 1. facilitator-diagnosis, 2. facilitator-treatment, 3. barrier-diagnosis, and 4. barrier-treatment. Ten interviews were coded by two researchers to ensure consistency in coding. The rest of the interviews were coded by one researcher. Coding was done using Atlas.ti 7. Codes were exported to Microsoft Excel and thematic analysis was done.

Ethical approval:

Ethical approval was obtained from the institutional review board at the James P Grant school of public health (JPGSPH). The dean of the school provided a request letter for participation for all the KIIs. Approval was also obtained from the BRAC tuberculosis program. Participants were informed of research objectives and were assured of anonymity and confidentiality. A voluntary informed written consent was obtained from the participants. All IDIs and surveys were conducted in a private area within the DOTS centres. Verbal consent was taken for the use of the voice recorders. All participants were offered light snacks and acknowledged for their participation. The de-identified data was used for analysis and preserved as per JPGSPH's institutional policy.

Results

This study complies with the guidelines of the Standards for Reporting Implementation Studies (StaRI) checklist (available as a supplementary material along with this manuscript: Additional file 2) [28].

Implementation pathway for diagnosis and treatment of childhood tb

Figure 2 shows the pathway of diagnosis and treatment of tb in BRAC operated areas in Bangladesh (insert figure 2 here). A suspected case is identified in the community (by SS) and send for sputum collection. Sputum is collected either at the mobile sputum collection camps or fixed clinics (DOTS centres in Urban areas or Upazilla Health Complex -UHC in rural areas). If the sputum examination is positive for *Mycobacterium tuberculosis,* treatment is initiated in the DOTS centre, but if negative, the child is referred to a paediatrician. Treatment for such children is initiated upon the recommendation of a paediatrician. The child is registered at the DOTS centre and medication is handed over to SS who lives close to the patient. Every morning, patients must visit the house of SS for medication. If for any reason, a SS is not available to provide medicine, alternate provisions were made to offer treatment under direct observation of a community leader or a family member. Treatment was monitored fortnightly by the field/program organizers and the area managers.

Survey findings

Final sample size collected was 111 (response rate = 95.6%). Table 1 shows the demographic characteristics of the respondents (insert table 1 here). The mean±Standard Deviation (SD) age of the respondents was 40.3 (± 0.9) years and work duration was 9.5 (± 0.3) years. The average number of adult tb patients treated over the last 12 months was 8 (± 0.7). About half (48.7%) of the respondents were from high performing centres. The average duration of treating a child tuberculosis patient was 6 years (± 1.1). The majority (89%) recalled that refresher training addressed over five out of seven components - diagnosis, treatment, disease prevention, isoiniazid prevention therapy (IPT), counselling, stigma, and supply chain.

Knowledge on childhood tb

Most of the participants (94%) knew children can be infected with tb. Less than a third had correct information about the transmission during childbirth (25%) and through breastfeeding (30%). One in four (23%) didn't know that fever of ≥2 weeks is one of the cardinal symptoms of tuberculosis in children. Only half (51%) identified that BCG vaccination could protect children from tb. About 96% knew tb is curable in children and 90% believed that adult drugs cannot be provided to them. Only one-third of the respondents knew that the duration of treatment of tb in children is the same as in adults.

KAP Score on different domains

The mean (± S.D.) for the total score on knowledge, attitude, and practices were 43.6 (± 0.5), 10.8 (± 0.9) and 13.2 (± 0.2) respectively. Detailed information on the scores (± S.D.), 95% CI on different domains of knowledge, attitude, and practices is available as a supplementary material along with this manuscript (Additional file 3).

Bivariate analysis

The knowledge on symptoms of childhood tb was significantly associated with the number of adult tb patients treated by SS in the last 12 months *(p=0.02)* and components of tb care addressed during training *(p=0.04)*. There was no association of KAP scores on respondent characteristics (age, duration of work, duration of treating child patients, number of patients treated). There was no difference in KAP scores among high performing and low performing centres.

Qualitative findings

Table 2 presents the key facilitators and barriers to implementation of childhood tuberculosis in Bangladesh for each of the three strategic pillars of "the End TB Strategy" (insert table 2 here). Figure 3 shows the factors that facilitated and hindered the diagnosis and treatment of childhood tuberculosis in Bangladesh (insert figure 3 here).

Pillar 1: Integrated patient-centred care

Training and capacity building

It was found that frontline health workers were adequately trained and played a key role in identifying potential cases and ensuring treatment compliance. A program manager at the national tuberculosis centre, which is the governing body for all activities for tuberculosis control in Bangladesh, informed that around 9000 doctors from Dhaka and Sylhet divisions, especially paediatricians were trained in childhood tuberculosis in 2013. Besides, the government of Bangladesh has developed training modules and guidelines individualized for different levels of healthcare professionals so that they can provide an appropriate amount of information required by healthcare workers. For example, periodic refresher training was provided to all SS. Each refresher training used to be a few hours long, mostly during the monthly meetings and addressed seven components (diagnosis, treatment, prevention, IPT, counselling, stigma, and supply chain).

The SS also mentioned that due to periodic refresher training they are confident talking about the preventive strategies, diagnosis criteria, and treatment for childhood tb.

"In the field level, their (community volunteers') role is to identify the suspects; they need to learn these criteria (for diagnosis)… they need to know how to refer these cases and when diagnosed, how to link these cases to DOTS provider..." (KII 4)

Active surveillance

Program/field organizers routinely visited patients at their home, cross-check medicine with SS or DOTS provider to check compliance to treatment. All the family members of a patient under treatment were closely monitored for symptoms of tb. Any presumptive cases sent for investigations were followed up until the results were obtained.

“To ensure they go for diagnosis, I go with them and help them with it, and if I can’t go, I contact them and ask whether they visited the doctor or not.” (IDI 27)

The complexity of diagnosis of childhood tb

It was reported that even doctors do not suspect tb during the initial workup of a sick child. Most of the time, children were diagnosed with tb only after physicians failed to reach other diagnosis.

“… When other diagnosis cannot prove, then the physician will be thinking that it might be a case of tuberculosis”. (KII 1)

The key informants highlighted that investigation like the Mantoux test, biopsy and culture were not available in most of the government health facilities (Upazilla health complex). Field organizers and SS highlighted that due to lack of proper investigations, people had to travel to the district hospital and tertiary care hospitals which resulted in financial constraints for the family.

Guideline for childhood tb

The introduction of guidelines for the management of childhood tb in 2012 was identified as a key turning point in identifying a child with tb. This guideline facilitated symptomatic diagnosis under-5 children eliminating the need for mandatory sputum examination.

Financial assistance for diagnosis

A program officer at the national tuberculosis control program informed that sputum examination and Mantoux tests were provided free of cost from all the health facilities, either public or private. The monitoring and evaluation manager of the BRAC tb program mentioned that the financial support provided by BRAC also contributed to increased case detection. It was revealed that sputum negative patients, referred from BRAC DOTS centre, were eligible to receive financial support (a maximum of 2000 Taka, equivalent to US$ 25 in 2017) as reimbursement of expenses for diagnostic tests related to tb. However, the field staff reported that most of the children were often unable to use this facility as they cannot produce sputum.

Awareness of childhood tb

The interview participants highlighted a lack of availability of information, education, and communication (IEC) materials on childhood tb. A key informant from NTP informed that the government of Bangladesh was working on audio-visual materials for childhood tb to be aired through the national media. It was further revealed that creating community awareness on childhood tuberculosis was the responsibility of implementing partners as they had funds for these activities. In contrast, the key informants from BRAC informed that it was the responsibility of the government to take the initiatives for awareness.

Delay in diagnosis

Figure 4 shows the pathway of diagnosis in four child tb patients who participated in the study (insert figure 4 here). Three out of four cases had months of delay in diagnosis. The parents of these children went back and forth between traditional healers, public, and private health facilities before they eventually visited tertiary care hospitals. Besides, all four mothers reported that despite having a range of investigations - for example, fine needle aspiration cytology (FNAC), GeneXpert, and magnetic resonance imaging (MRI) - tb was suspected when other conditions were ruled out.

Active monitoring of treatment:

The treatment of tb (DOTS) is supervised mostly by the SS. The BRAC program manager revealed strict supervision ensured higher compliance with treatment. In-depth-interview with SS revealed that every day, a patient had to visit their home for medication. If a parent doesn't come for medicine, they visit the patient's home to provide medicine and counsel them on the importance of completing the total dose of medicine. The SS considered that to make a child take medication for six months was a herculean task. Besides, if any member of a family is diagnosed with tuberculosis, children in those families are monitored for the symptoms of tuberculosis, and if eligible, provided with isoniazid prevention therapy (IPT) for six months.

"The medicine is for 6 months. After completing the dose for 2 months, the child starts feeling better. That time child does not want to continue medicine. These are the barriers. That is why our duty (supervision) is going on". (IDI-3)

Children friendly regimen:

The government has introduced child-friendly drugs with fixed drug combinations (FDC) for tb. An orally dispersible tablet was available with 2FDC (Isoniazid, Rifampicin) and 3FDC (Rifampicin, Ethambutol, and Pyrazinamide) combinations. However, there is no child-friendly regimen for the 4FDC combination (Isoniazid, Rifampicin, Ethambutol, Pyrazinamide). Those who need to take 4FDC need to take 3FDC and isoniazid. Taking two tablets instead of one was not easy for children. Besides, children often vomit out medicine. Difficulty in administrating medicine was an important factor that hindered the treatment in children. Mothers of two children, aged thirteen months and six years respectively, expressed it was difficult to give medicine to small children.

Pillar 2: Bold policies and supportive systems:

A key informant from the WHO country office claimed that there was smooth coordination between NTP and partner organisations. Periodic policy review and addressing gaps and challenges through the Joint Monitoring Mission (JMM), conducted every 3 years, was one of the key reasons behind the successful implementation of the tb control program in Bangladesh. For example, the JMM had identified a shortage of trained human resources as a key challenge for childhood tuberculosis and the government responded by intensified training of paediatrician and other health care workers. The government has introduced childhood tb management into the MBBS curriculum following suggestions from JMM. The medical

students are oriented on existing protocols with the hope of creating uniformity and reduce the load to train one of the important groups of health professionals.

Pillar 3: Intensified research and innovations:

A key informant from NTP highlighted the need of investigating the effectiveness of the recently developed mobile application for case notification. He further mentioned the need to evaluate the outcomes of introducing childhood tb guidelines in the MBBS (bachelor of medicine and bachelor of surgery) curriculum. However, the key informants had divided voices on who should be engaged in supervising the research activities. Key informants from BRAC and Damien foundation suggested the government should take initiatives. On the other hand, the government authorities pointed out that conducting research was the responsibility of the partner organisations. Both parties agreed on the lack of budget for research activities.

Discussion

In this study, we investigated the facilitators and barriers to the implementation of childhood tb in Bangladesh. The study identified multiple strategies to intensify diagnosis and treatment. For example, the provision of specific guidelines for childhood tb, co-ordination between the partner agencies, capacity building of health care workers, and the introduction of GeneXpert. The government's effort in identifying childhood tb was reflected by a steady increase in the rate of case notification over the past few years [16, 29]. We found that most of these strategies were working smoothly whereas some did not. A frequent turnover of the key managerial positions in the government health system was identified as one of the biggest challenges for the implementation tb program in Bangladesh. As key government officials are often rotated, implementing partners find it difficult to negotiate with the government for the implementation of new and effective strategies.

Despite many efforts, Bangladesh is still lagging in case detection of childhood tb [16, 29]. Frequent turnover and absenteeism of paediatricians in the UHC and district hospitals contributed to the delay in diagnosis and commencing the treatment. It was coupled with a lack of training for medical officers, who are the frontline doctors in these health facilities. As such, the focus of capacity building should be concentrated on the medical doctors so that many children with tb can be identified. Although it was revealed that the government has stepped up to incorporate the national tb program in the MBBS curriculum; it will take years to observe the effect of this policy change as we need to wait for few years for these medical students to graduate and start their clinical practice. Further, engaging private practitioners like private hospitals, paediatric clinics, and pharmacies into mainstream tuberculosis control programs were identified as another key challenge. The key informants believed that private practitioners may be practicing a different treatment regimen. A recent study in India showed variation in tb prescription patterns among private practitioners [13]. If the private practitioners can be brought under the umbrella of the national program, it can help identify more cases and ensure uniformity in the treatment.

The role of community health workers is crucial in reducing the burden of a communicable disease like tuberculosis. It was reported that the capacity building of the health workers played an important role in the successful implementation of the tb control program in Nigeria and Kyrgyzstan [30]. Besides, extensive door to door coverage by the frontline healthcare workers led to successful immunization campaigns in Nepal and Bangladesh [31, 32]. Our study found that frontline health care workers (SS) were able to provide a clear and concise message about childhood tb in the community. In contrast to our study, previous studies reported a lower level of knowledge on childhood tb among the frontline health care workers in Bangladesh [13, 33]. Content-specific training modules and periodic refresher training could have attributed to the increased level of knowledge, attitude, and practices among the frontline healthcare workers.

The use of GeneXpert was linked with increased case detection of childhood tb. The GeneXpert technology can be used with sputum, blood, and other tissues such as lymph nodes. As most of the childhood tb patients are either smear-negative or extrapulmonary [34], GeneXpert may bring revolution in the diagnosis of childhood tb. Studies have suggested that GeneXpert may contribute to increased case detection both in adults [35] and in children [36]. But a limited number of GeneXpert machines could be a potential challenge. In 2016, there were 56 GeneXpert machines across Bangladesh, mostly in large cities [8]. Key informants mentioned that the number of GeneXpert machines will be increased. However, there is a probability that these machines will not be uniformly distributed to rural areas. The government should expand the diagnostic facilities including GeneXpert, chest X-ray, and FNAC services at least to the Upazilla level to enhance early identification of suspected cases.

The DOTS therapy may play an important role in successful treatment. For example, in Ethiopia, DOTS improved treatment success rate from 13% in 1992 to 92% in 2013 [37]. Due to the effective implementation of the DOTS program, Bangladesh has one of the highest treatment success rates for tb in the world [16]. As children frequently cough or vomit out the medication, it is difficult to persuade parents to ensure their child takes medicine regularly. Henceforth, the provision of DOTS may be more important in treating childhood tb. The frontline health care workers used to conduct a door-to-door visit of each tb patient and counsel parents on the importance of continuing treatment for the entire duration.

Besides, it was reported that due to a lack of IEC materials on childhood tb, it was difficult to educate the parents and community about tb in children. The amount of IEC materials on childhood tb was limited. During our survey, IEC materials on childhood tb were found only in two centres. The gap in the availability of IEC materials was consistent with the findings of a recent study conducted on childhood tb in Bangladesh [13].

Bangladesh is globally renowned for research and innovations on tuberculosis. For example, research on a treatment regimen for multi-drug resistant tuberculosis (MDR-TB), conducted in Bangladesh, suggested reducing the treatment duration from 22 months to 9 months (the Bangladesh Regimen) [38]. But both the government and implementing partners had no concrete roadmap for research activities in childhood

tb. Lack of research activities could prevent identifying possible mechanisms to improve case identification and treatment compliance.

Conclusion

A triad of strategies including capacity building of frontline health care workers, use of recent technological advances in diagnosis and continuous monitoring of the suspected or identified cases in the field has resulted in a sustained increase in case notification of childhood tb over the past few years. Frequent turnover and change of key positions in NTP and absenteeism of paediatricians in government hospitals were important barriers to implementation of childhood tb program. The spectrum of active case detection, currently limited to surveillance among the family members of the sputum positive cases, needs to be expanded. Absence of IEC materials on child tb coupled with lack of awareness and stigma in the community hindered the program. The government needs to address these issues to improve case detection and reduce the burden of childhood tb.

Strength

We conducted a mixed-methods study to review the implementation pathway of childhood tb in Bangladesh. Our study involved the policymakers, program managers, the frontline health workers, and the consumers who received these services. Triangulation of the findings from the survey and in-depth-interviews adds to the validity of the study. Further, we had views from different stakeholders to identify the key factors that enabled and hindered the implementation of the childhood tb control program in Bangladesh.

Limitations

As the study period was very short, we could not manage to go beyond the urban tb areas. A comparison between the urban and the rural areas and between government-operated areas and NGO (non government organisation) operated areas would have provided a better insight into the program itself. Although we initially planned to conduct an focus group discussion with the mothers of child tb patients, it was not feasible due to the scattered distribution of the child tb patients. As a result, we conducted IDIs. We also wanted to conduct IDIs with an informal health care provider, but this was also not possible due to time constraints. Further, we were not able to survey other health care providers.

Abbreviations

RECID/N Research for Integrated Development/Nepal

WHO World Health Organisation

Tb Tuberculosis

DOTS Directly Observed Treatment, Short-course

KAP Knowledge, Attitude, and Practice

SS Shasthya Shebika

NTP National Tuberculosis Program

BCG Bacillus Calmette-Guerin

KII Key Informant Interview

IDI In-Depth Interview

JPGSPH James P. Grant school of public health

StaRI Standards for Reporting Implementation Studies

UHC Upazilla Health Complex

SD Standard Deviation

IPT Isoniazid Prevention Therapy

IEC Information, Education, and Communication

FNAC Fine Needle Aspiration Cytology

MRI Magnetic Resonance Imaging

FDC Fixed Drug Combination

JMM Joint Monitoring Mission

MBBS Bachelor of Medicine, Bachelor of Surgery

MDR-TB Multi-Drug Resistant Tuberculosis

NGO Non-Government Organisation

Declarations

Ethics approval and consent to participate

This section has been described in the methodology section of the manuscript.

Consent for publication

Not applicable

Availability of data and materials

Data will be added to the institutional repository of James P Grant School of Public Health. Data will be made available based on the institutional policy of JPGSPH.

Competing Interest

All the co-authors declare they do not have any conflict of interest.

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Authors' contributions

All authors were engaged in the design of the study. SP, MJA, SMH, SC, and UD collected the data. MS was the principal supervisor of the study whereas RDG, IS and RB were moderators. SP analyzed the data and prepared the first draft of the manuscript. All authors reviewed and contributed to the final draft of the manuscript.

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Tables

Table 1: Demographic Characteristics

Category (n=111 expect otherwise stated)	N (Percentage)
Age	
<30 years	10 (9.0)
30-50 years	80 (72.1)
>50 years	21 (18.9)
Education	
Never Attended	23 (20.8)
Primary	41 (36.9)
Secondary	41 (36.9)
Higher Secondary or Above	6 (5.4)
Number of adult patients treated (provided medicine) in past 12 months	
<2	3 (2.7)
"2-5"	2 (28.8)
"5-10"	41 (36.9)
>=10	35 (31.6)
Number of adult patients who completed treatment in past 12 months	
<2	5 (4.5)
"2-5"	42 (37.8)
"5-10"	40 (36.0)
>=10	24 (21.7)
Duration of providing medicine to child tuberculosis patients *(n=40)*	
<2 years	14 (35)
2-5 years	15 (37.5)
5-10 years	4 (10)
>=10 years	7 (17.5)
Duration of Work	
<5 years	11 (9.9)
5-10 years	35 (31.5)
>=10 years	65 (58.6)

Performance of Centers	
High Performing Centers	54 (48.7)
Low Performing Centers	57 (51.3)

Table 2: Facilitators and Barriers to childhood tuberculosis control program in Bangladesh

	Facilitator	Barrier
Pillar 1 **Patient-Centered Care**	1. Door to door identification of presumptive cases 2. Periodic refresher trainings for frontline health workers 3. Capacity building of Pediatricians 4. Provision of pediatricians in Upazilla Health Complex 5. Newer diagnostic tools like GeneXpert 6. Financial support for investigations of tuberculosis 7. Specific guidelines for childhood tb 8. Specific training manual for training different cadres of health workers. 9. Active surveillance, frequent monitoring and supervision of the diagnosed cases during treatment 10. Presence of Child-friendly drugs and effective DOTS therapy 11. effective supply chain management of drugs and other equipment	1. complexity of the disease and its diagnosis process 2. inadequate distribution and absenteeism of pediatricians in health facilities 3. lack of capacity building activities for Medical Officers 4. lack of modern investigations in the government health facilities; especially in the Upazila level. 5. Presence of stigma and lack of IEC materials on childhood tuberculosis 6. lack of co-ordination between the private practitioners and DOTS centers 7. No child-friendly 4FDC regimen 8. Mandatory provision of sputum examination for financial support 9. No financial support for complications arising during treatment.
Pillar 2 **(Bold Policies and Supportive System)**	1. Government ownership 2. separate unit for childhood tb control program 3. effective coordination between government, NTP, and NGOs 4. Childhood tb management protocol introduced into the MBBS curriculum. 5. Direct involvement of partner organizations including BRAC and Damien Foundation 6. Guidelines for adequate stock of medicines both at the central and peripheral level.	1. Frequent turnover of high-level authorities in the ministry and NTP 2. Gaps in regular review meetings between NTP and NGO partners 3. Lack of adequate funding in Tb program
Pillar 3 **(Intensified research)**	1. Presence of WHO standard laboratory in Bangladesh 2. Presence of laboratories at the regional level	1. Lack of adequate fund for research both with NTP and with implementing partners.

	3. Engagement of some of the implementing partners (icddr,b) in research	2. Lack of effective co-ordination between partners for research and innovations

Figures

Methods		Respondents	Objectives addressed
Quantitative Component	survey	Shasthya Shebika (SS) (n=116)	To find out the knowledge, attitude and practices of childhood tuberculosis among the frontline health care workers
Qualitative Component	In-depth interview (IDI)	SS (n=18), Program organizers (n=6), Laboratory technicians (n=2), Area managers (n=2), Mother of children with active TB (n=4)	To explore the field level challenges in implementation of childhood tuberculosis
	Key informant interview (KII)	Senior officials from BRAC (n=4), National Tuberculosis Program (n=2), Damien Foundation (n=1), WHO National Professional Officer (n=1), tuberculosis research specialist (n=1)	To explore the implementation pathway, strategic policies around childhood tuberculosis

Figure 1

Shows the detailed information about the study population, the number of respondents, and the objectives addressed by different components of the study

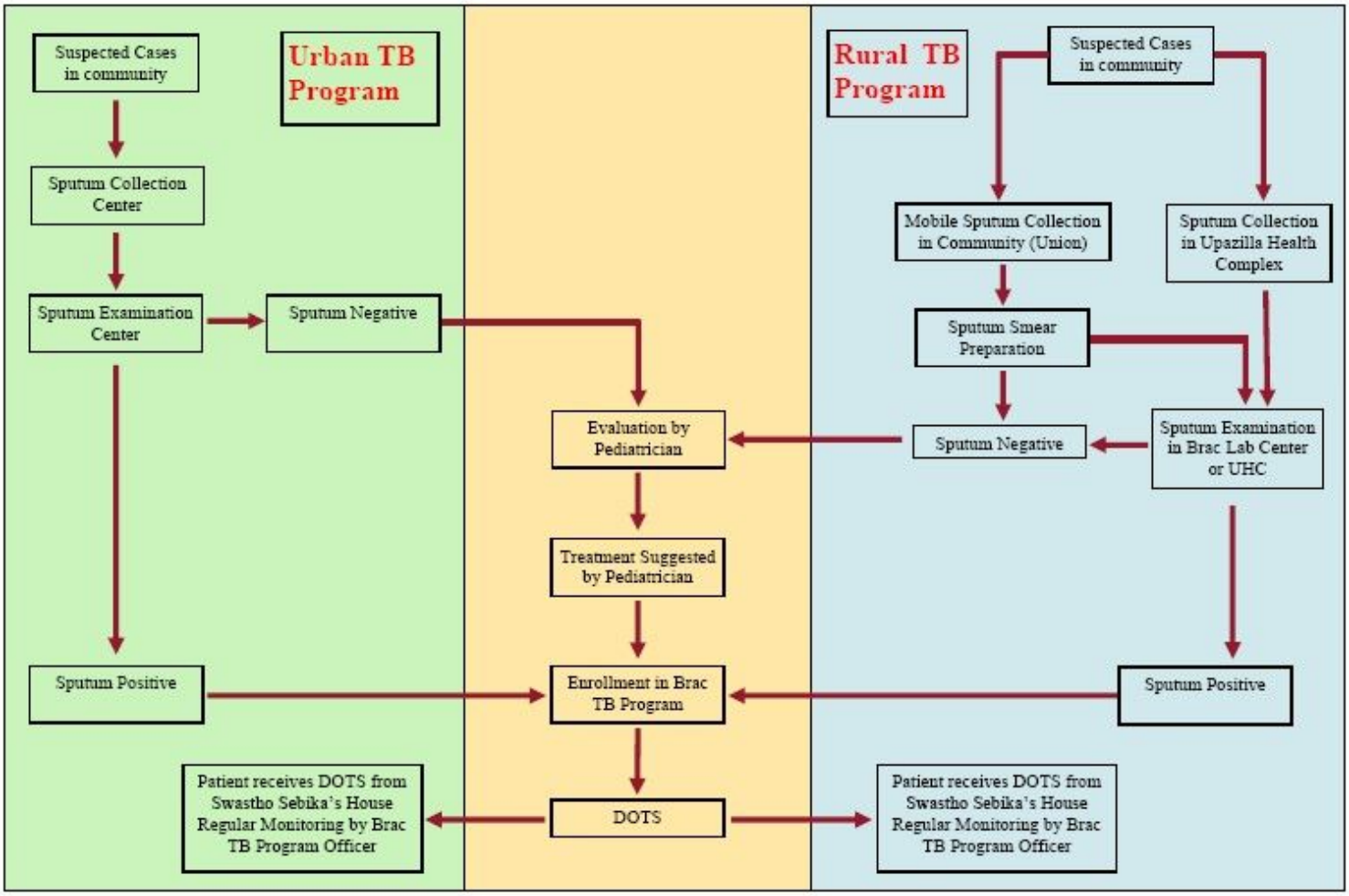

Figure 2

Shows the pathway of diagnosis and treatment of tb in BRAC operated areas in Bangladesh

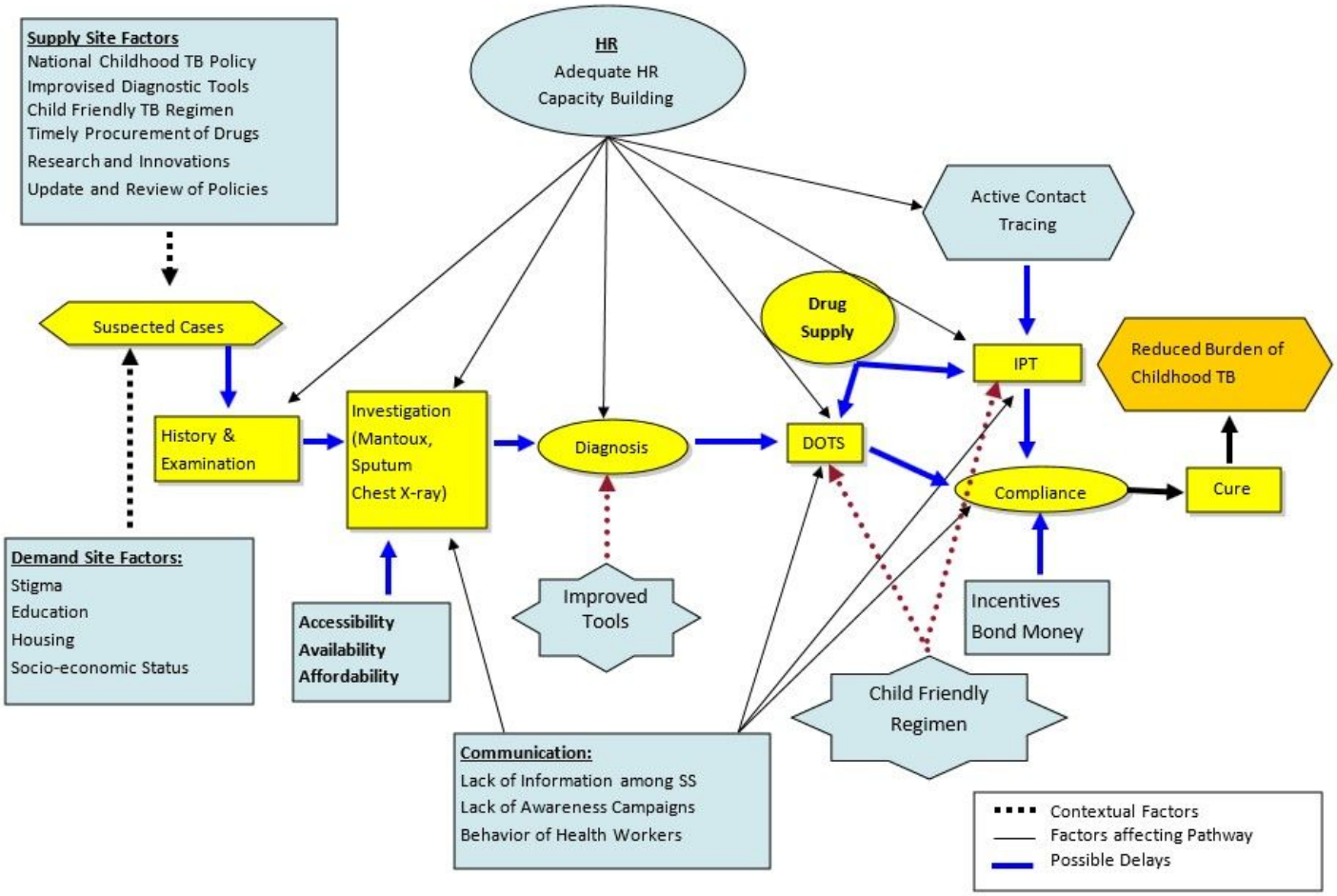

Figure 3

Shows the factors that facilitated and hindered the diagnosis and treatment of childhood tuberculosis in Bangladesh

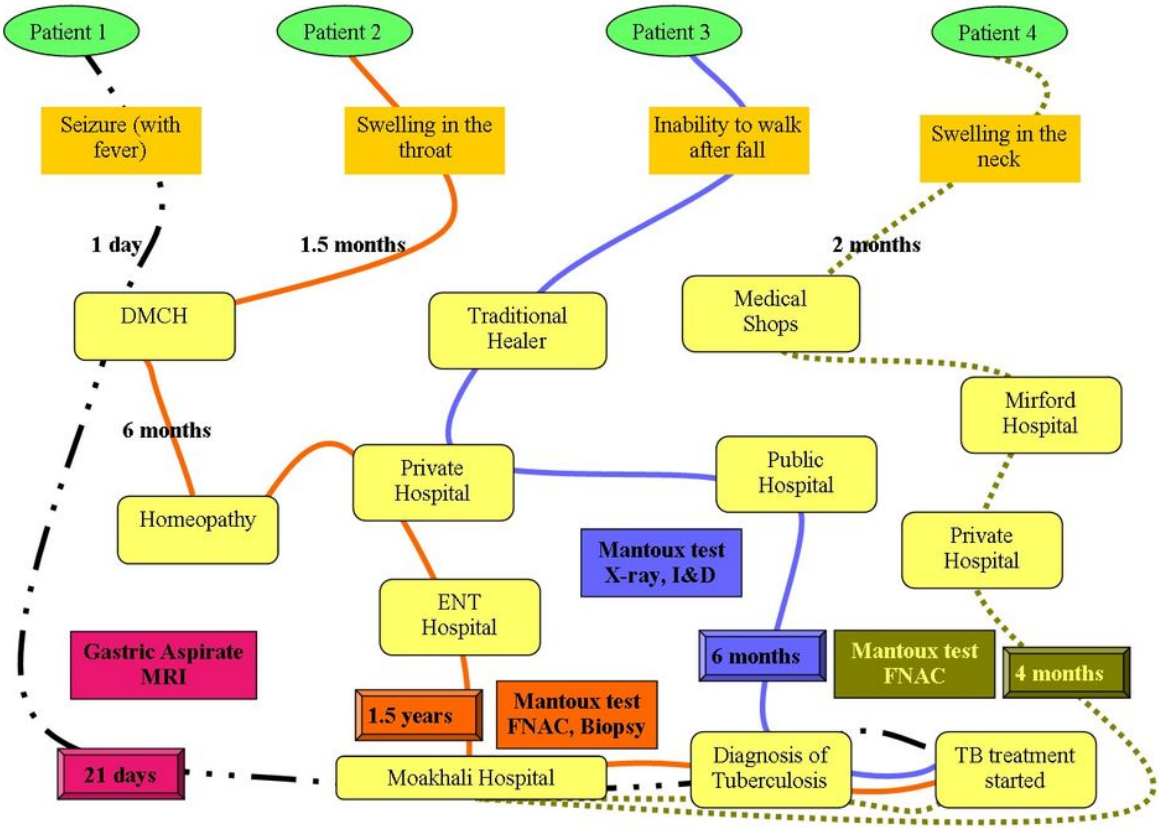

Figure 4

Shows the pathway of diagnosis in four child tb patients who participated in the study

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementarymaterial3KAPscores.pdf
- Supplementarymaterial2StaRIchecklist.pdf
- Supplementarymaterial1questionnaireKAPsurvey.pdf