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Perceived Feasibility of stool-based Tuberculosis diagnostics in children and adults with HIV in Uganda and Eswatini: Healthcare workers' perspectives

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Abstract

Background

Tuberculosis (TB) is the leading infectious killer. Diagnosis in people with HIV and children is limited due to the paucibacillary nature of the disease; respiratory specimen collection and diagnosis in these groups can be difficult, often requiring semi-invasive methods for sampling. This study explored the feasibility of stool-based TB diagnostics for tuberculosis as an alternative to sputum in Uganda and Eswatini, focusing on healthcare workers' (HCWs) perceptions.

Methods

In this qualitative study, researchers used semi-structured interviews in Uganda and In-depth Interviews and one focus group discussion in Eswatini to explore HCWs' perceptions of stool-based TB diagnostics. This study was conducted at TB clinics in Uganda (Kampala) and Eswatini (Hhohho and Manzini). HCWs were selected using purposive and convenience sampling. The researchers analysed the transcribed interviews using deductive content analysis guided by Bowen's feasibility framework to identify key themes related to the feasibility of stool-based TB diagnostics.

Results

Interviews with 21 HCWs in Uganda and Eswatini revealed perceived high acceptability of stool-based TB diagnostics, primarily due to their non-invasive nature and being favourable for children, particularly when sputum collection is challenging. HCWs reported high demand when standard sample collection kits were unavailable. However, implementation faces significant barriers: reluctance among adults, often resulting from cultural beliefs and aversion to stool, logistical challenges such as difficulty providing samples promptly and travel costs to return with the stool sample to the health facility, and the need for new resources, infrastructure upgrades in terms of sanitation facilities, public sensitisation and staff training to overcome resistance and ensure successful roll-out.

Conclusions

According to HCWs, stool-based TB diagnostics are highly acceptable and favourable for children. Integration of stool-based diagnostics will require a comprehensive approach, including securing external support, upgrading facilities, training staff and sensitising the public.

Trial registration:

This study is part of the Stool4TB study, registered on 2021-09-08 at ClinicalTrials.gov under ID NCT05047315(1).

INTRODUCTION

Tuberculosis (TB) is the leading cause of death by a single infectious agent, with 1.23 million deaths worldwide. About 10.7 million people in the world developed TB, which was an increase in the past 4 years after the disruption caused by the COVID-19 pandemic. Africa contributed 24% of the total incident cases, second only to South-East Asia.(2). With the high burden of HIV/AIDS in Africa, 414,000 TB patients were notified as living with HIV. Yet tuberculosis has been seen as one of the greatest threats, with a greater than twenty-fold increased risk of TB disease progression compared with their HIV negative counterparts(3, 4) and are more susceptible to developing extrapulmonary TB. In settings where the most widely used diagnostics only look for pulmonary TB, there is a disproportion between incident cases among children and access to appropriate diagnosis (5). Part of the reason lies in the demand side, whereby delays or refrained care seeking at health facilities is present, particularly regarding children, which is linked to a lack of awareness of signs and symptoms suggestive of TB(6, 7). On the other hand, there are missed opportunities to test suspected cases and inaccurate diagnostic tests that are less effective among children (5). For instance, a study conducted in Mozambique with caregivers of minor patients and people with HIV (PWH) has shown that delays in seeking care were common among participants with TB symptoms, reflecting limited awareness of the disease. Factors such as waiting for the next scheduled doctor's visit, misinterpreting symptoms, and misconceptions about TB may have contributed to these delays (7). These facts reveal that poor access to appropriate diagnosis and treatment persists as a significant limitation in many low-resource settings, resulting in high case fatality rates.

Additionally, bacteriological confirmation has been observed to decrease, especially in high-TB-burden, low-income countries such as Uganda and Eswatini (2). Until recently, only respiratory samples were required for TB diagnosis using various tests, including molecular tests such as Xpert MTB/RIF Ultra, or microscopy tests such as the Fluorescence TB smear. Studies document that overall diagnostic and microbiological confirmation of TB in children and PWH is suboptimal due to the lack of specificity of clinical symptoms and challenges in collecting respiratory samples, jointly leading to a poor diagnostic yield (8–10). Spontaneous sputum samples are not always obtained, particularly in children and very sick PHW; more often, traumatic sampling is required, which involves gastric aspiration or inducing sputum production followed by nasopharyngeal aspiration (9, 10). Such procedures have always shown certain limitations in terms of tolerability and acceptability in low-resource settings(7). Therefore, the World Health Organisation (WHO) called for more information on evaluating the feasibility and acceptability of different and user-friendly diagnostic technologies, such as Stool-based TB qPCR, as research priorities(9).

Identifying the barriers and facilitators of stool-based TB diagnostics enables the evaluation of the acceptability of future healthcare services, which, in the end, will assist decision-makers and

implementers in making informed decisions. Existing studies have found that HCWs had a positive attitude towards the use of stool-based TB diagnostics, especially among those who struggled with producing sputum (11, 12). There are no specific data on the perceived feasibility and acceptability among HCWs in Eswatini and Uganda. Our aim was therefore to explore the perceptions of HCWs in Uganda and Eswatini on the feasibility of using stool-based TB diagnostics in children and adults with HIV.

METHODS

Study Design and Setting

As part of the Stool4TB study (13), we conducted a multi-country qualitative study in two countries, including Uganda (Kampala City) and Eswatini (Hhohho and Manzini region)

In Uganda, the study was conducted at densely populated TB clinics in Kampala, including Mulago National Referral Hospital (Wards 5, 6, and 15), China-Uganda Friendship Hospital, Naguru TB clinic, Kisenyi Health Centre IV, Kawaala Health Centre IV, and Kitebi Health Centre IV.

In Eswatini, the study was also conducted in the Hhohho region, home to the administrative capital Mbabane, with approximately 320,000 people, and the Manzini region, the economic hub and most populous area, with 355,000 people. Both regions have relatively better healthcare infrastructure than rural areas, but still face HCW shortages, limited diagnostic capacity, and high disease burdens driven by the HIV-TB epidemic. This study was conducted explicitly at Raleigh Fitkin Memorial Hospital in Manzini region, and Dvokolwako Health Centre and Pigg's Peak Government Hospital in the Hhohho region.

Participants and Sampling

The study population comprised HCWs based at the aforementioned health facilities. These participants were involved in the screening, diagnosis, treatment, follow-up, and discharge of TB patients under the oversight of the National TB Programs. The HCWs included medical doctors, nurses, laboratory technologists, and counsellors. The counsellors are also involved in community-based activities, such as community health talks and contact tracing.

Participants were purposively selected based on the inclusion criteria, with convenience sampling used to recruit available HCWs(14). HCWs were enrolled in the study if; aged ≥ 18 years old, worked as a medical doctor, nurse, clinical officer/health technician, or community health worker, worked in the public, private, or informal sector within the selected facility catchment area; dealing with TB patients; with work experience of at least 2 years; and, finally, willing to participate in socio behavioural study (SBS). Exclusion criteria included involvement as a collaborator in the Stool4TB study or being on leave during the scheduled period for the SBS activity.

Data collection tools and procedures

For data collection, each site developed context-specific tools. In Uganda, 10 semi-structured interviews (SSIs) were conducted using open-ended questions arranged in a predefined sequence. In Eswatini, data collection included one focus group discussion (FGD) and three in-depth interviews (IDIs), all guided by open-ended questions. The SSIs and FGD aimed to explore participants' experiences and perspectives on the usability of stool-based procedures, as well as their own and patients' willingness (acceptability) to provide stool samples for TB diagnosis. The IDIs, in turn, were designed to capture participants' practical experiences in requesting and performing stool sample collection.

The interviews were primarily conducted in English (the official language) between December 2022 and August 2024, with participants permitted to switch to local languages (Siswati in Eswatini and Luganda in Uganda) during the discussions. Informed consent was obtained from all participants before the interviews. With participants' consent, interviews were digitally recorded; otherwise, detailed field notes were taken by assigned research assistants. Data collection was carried out by two research assistants in Uganda and Eswatini who were fluent in both English and the relevant local languages, experienced in qualitative interviewing, and trained in the study protocol. The research assistants were supported and supervised by the respective site study coordinators, who reported to the overall study coordinator and the principal investigator.

The recordings and field notes were stored on the study site's servers, with restricted access granted to the study team. All data generated from this study and stored on the site's server will remain protected for 10 years and will be accessed only for research purposes with the explicit approval of the Stool4TB steering committee.

Data processing and analysis

While data collection took place, interview recordings were transcribed verbatim by research assistants. All vernacular content was translated into English during transcription. Repeated words, incomplete sentences, and hesitation markers were removed for readability, while missing or implied words were added in brackets to preserve meaning and ensure clarity. To ensure participant anonymity, all summaries and transcripts were de-identified using unique participant codes such as "Eswatini HCW1 or Uganda HCW1" for SSIs and "Eswatini HCW FGD A" for FGDs. In the presentation of findings, participants are referenced by their country of origin and the chronological order of their interview.

To ensure data quality, the site study coordinators (JN/FS) conducted quality control checks during data collection by reviewing each interview recording and verifying it against the corresponding transcript. In addition, the multi-country coordinator (AL) and the principal investigator held bi-weekly debriefing sessions with the site coordinators (JN/FS) to support ongoing quality assurance. Following these sessions, the site coordinators met with the research assistants to provide feedback on the quality control findings and offer recommendations for improvements.

To analyse the data, interview transcripts were converted to plain text and imported into Open Code 4.03 software(15) for deductive thematic analysis guided by a feasibility framework (as outlined by Bowen, Fig. 1) (16). This framework examined four key aspects of stool-based TB diagnostics: *Uptake*; whether HCWs find stool testing suitable, attractive, and satisfactory for their practice (17). *Demand*: the likelihood that HCWs and patients will actually use stool testing, which may be influenced not only by their preferences but also by power dynamics between HCWs and patients (16). *Practicality*: how easily stool testing can be carried out within existing time constraints and available human and material resources (18). And *implementation*: whether the health system can successfully deliver stool-based TB diagnostics using existing infrastructure sustainably and realistically, considering both the resources needed and costs involved (19).

Each construct of the feasibility framework (acceptability, demand, implementation, practicality, adaptation, and integration) was translated into codes, with their respective elements developed as sub-codes (e.g., uptake → suitability, attractiveness, and satisfaction). In addition to the predefined codes, emerging themes were also coded and organised into sub-codes (e.g., demand → overall willingness, geographical differences, barriers and facilitators). An independent reviewer (AL) verified the resulting themes, sub-themes, and analytical categories (codes and sub-codes) to ensure reliability, and these were further refined to illustrate the content and relationships within the data.

RESULTS

In this study, we recruited 21 HCWs, 10 from Uganda and 11 from Eswatini. Most participants were young adults aged 18–39 years, including both men and women. They were primarily drawn from the public sector and included nurses, laboratory technicians, and medical doctors, most of whom held qualifications ranging from diploma to degree level.

Table 1
Demographic characteristics of the participants.

Characteristics	Eswatini Total (n = 11)	Uganda Total (n = 10)
Age Group		
Young adults (18–39)	8 (72.7%)	6 (60.0%)
Middle-aged adults (40–59)	3 (27.3%)	4 (40.0%)
Elderly (60+)	0 (0.0%)	0 (0.0%)
Gender		
Female	6 (55.5%)	5 (50.0%)
Male	5 (45.5%)	5 (50.0%)
Marital status		
Single	5 (45.5%)	7 (70.0%)
Married	6 (55.5%)	3 (30.0%)
Education Level		
Diploma	7 (63.6%)	2 (20.0%)
Graduate	3 (27.3%)	6 (60.0%)
Postgraduate	1 (9.1%)	2(20.0%)
Cadre		
Laboratory Technologist	2 (18.2%)	3 (30.0%)
Medial Doctor	2 (18.2%)	5 (50.0%)
Medical Social Worker	0 (0.0%)	1 (10.0%)
Nurse	5 (45.4%)	1 (10.0%)
Pharmacy Technician	2 (18.2%)	0 (0%)
Employment Sector		
Public	10 (90.9%)	10 (100%)
Non-Government Organisation (NGO)	1 (9.1%)	0 (0%)

Perceptions on the feasibility of stool-based TB diagnostics

Acceptability: Is stool testing suitable, satisfying or attractive to HCWs?

All HCWs thought that the stool-based TB diagnostics would be suitable for those who have difficulties in producing sputum, particularly children.

“It is going to be helpful because there are people that cannot cough up sputum. For us to be able to do the GeneXpert, I think the stool will be helpful. It could be children, and it could be an adult that is coughing but who is not productive and cannot produce the sputum” (Eswatini HCW 3).

Supporting this *perspective, another participant was more sceptical about how adult patients would respond, suggesting that caregivers of infants would be more receptive to the technique than adults*.

“[…] I would say that it would be very good for children. I am not sure about adults, [chuckles] […], but for children? Yes! Because the number is not that many for the children. Like when they come to the clinic, and the parents can easily get the sample, like getting it from the diapers is easy. For adults who run busy clinics […]. I don’t know anyway” (Uganda HCW 2).

Furthermore, participants found it attractive, describing it as “*an easier way of diagnosing TB as opposed to the sputum*” (Eswatini HCW 3). This perspective is influenced by the perception that stool samples are easier to collect than sputum in specific patient groups, by the non-invasive nature of stool collection, and by the challenges of accessing standard diagnostic procedures such as X-rays and GeneXpert, which are not always operational.

"I think it will be accepted. I totally agree […]. Because it is simple and easy to use. And it is non-invasive" (Ugandan HCW 9).

“*Some people can’t produce sputum even though they have TB, and we sometimes go on for a long period without an operational X-ray machine. It is also hard for people in rural areas to come to Pigg’s Peak for X-ray. It is easier to collect stool. So that is how I took it when I first heard about it*” (Eswatini HCW 2).

Additionally, one HCW highlighted that stool-based TB techniques are more cost-effective than other methods.

“All the other methods are very expensive. But on top of that, sometimes getting a good sample from some people may be very challenging, especially in children.” (Uganda HCW 10).

Based on these considerations, participants believed that a stool-based TB diagnostic could meet the needs of both HCWs and patients for an alternative diagnostic method, such as a stool-based intervention, thereby leading to greater satisfaction translated into higher acceptability among both groups.

“I think they [will] buy it […] since there is no pain in defecation, there is no surgical operation, there is no medical procedures involved” (Uganda HCW 6).

“I think they will take it up because it is simple. I think it will be accepted. I totally agree” (Uganda HCW 9).

One HCW from Uganda suggested that this acceptability may stem from patients having limited alternatives, highlighting the influence of power dynamics between HCWs and patients, as well as patients’ desire to receive a diagnosis.

"Most of the time they have no option... because they know it is about their diagnosis. Diagnosing their infection." (Ugandan HCW 4)

Demand: To what extent is stool TB testing likely to be used?

Almost all HCWs believed that demand for Stool-based TB diagnostic methods would be most significant in situations where conventional diagnostic methods are unavailable or when obtaining a good sputum sample from a patient is not possible.

“*So, what I think […] it is a good modality, because it is an alternative for those that do not produce sputum. […], since the children cough and swallow, so you can have bacteria in the stool. So, I think it is a good modality*” (Ugandan HCW 10).

Nonetheless, they cautioned that initial demand might be limited, with resistance expected particularly among adult patients and some HCWs. Moreover, three HCWs in Eswatini reported resistance, especially from patients living in suburban and rural areas. Such reluctance may arise from discomfort or aversion to the samples' odour, as well as from misconceptions or even entrenched local beliefs. For instance, one HCW from Eswatini explained that:

“People who usually decline are those that live in suburbs, in urban areas. Those clients that go to MGH. They say they can’t look at their stool. They feel the other samples are better. Otherwise, when you go to the rural areas, we never come across such comments. It is patients from town that have this problem. [Whereas] people in rural areas decline because they are too rooted in traditions. They feel like I can’t take my stools to foreign people because I don’t know what may happen. It doesn’t matter what we say we will do with the stool, but because we are Swazis, we have our beliefs [on witchcraft]” (Eswatini HCW 3).

Additionally, HCWs noted that some patients may struggle to provide stool samples promptly, either because of difficulty producing them or because they need to return to the health facility on subsequent days, a challenge often compounded by travel costs associated with long distances.

“[...] The only issue is how to collect that sample, because they will need maybe a day. Some people don’t come ready to pass stool. So, they would need probably a day, or someone may need like 2 days, but I think it is okay. It can be another method that can be used. Because if it can be used, why not? In young children,

possibly […] maybe! But it is not an immediate method. And some of them may not have eaten, so they may not have stool. It can, however, be used […]" (Uganda HCW 2).

"Most of the time, they state the lack of transport money. You find that the date to bring the stools does not correspond with the date to come to the health centre" (Eswatini HCW 4).

Despite these challenges, they are confident that greater dissemination of information and increased familiarity among both patients and HCWs will help to overcome these barriers over time.

"I would say as time goes on, people are accepting it" (Eswatini HCW 1).

"When we sit down and talk to them about where it will help them, then they agree to do it because they realise they will be assisted. Let us see how far you can help me. Awareness is the one that should lead, and they can hear about it on the radios, social media and by doing campaigns in the community where they educate the people that there is now something like this. There are also benefits to it" (Eswatini HCW A FGD).

"They will accept if they are sensitised well on how to do it, if they are educated on how to do it. They can do it" (Uganda HCW 1).

"Yes, I agree that it is disgusting, but we have a way... You also show them how they will pack it so that it does not smell" (Eswatini HCW C FGD).

Implementation: To what extent can stool TB testing be successfully delivered to intended patients?

HCWs identified multi-level implementation requirements spanning training, resources, and systematic preparation. Implementation was viewed as achievable but resource-dependent.

"Yeah, things to do with infections of the GIT […], that is, gastrointestinal tract infection. Uh […] Things to do with worms, things to do with diarrhoea, or that anaemia. We use it. Sometimes we use it for typhoid diagnosis of typhoid. So, we have been using it in different methods" (Uganda HCW 4).

"There will be a challenge of supplies. I do not know what kind of equipment they will use, whether it will be centrifuged, [whether they will] use GeneXpert or not… we really [need] to find sources of this equipment that we are willing to implement. I think we can work with some TB partners to support with these consumables." (Uganda HCW10)

However, they highlighted several challenges at multiple levels that, if not adequately addressed, could hinder successful implementation, such as limited public awareness of the intervention, insufficient personnel training, and logistical or procurement constraints.

"It would be a suggestion that we would like the Ministry of Health to inform the whole nation, so that we all know about how TB is now being diagnosed [...]. If there was a way, maybe they can have a health program on radio and introduce this" (Eswatini HCW B FGD).

"Because it is simple and easy to use. And it is non-invasive. So, it's basically procurement, maybe talking to the relevant stakeholders to see [to] it that we get the commodities. And also, […], the staff will need to be taught about this. So, the staff will do the training… about this new modality" (Uganda HCW 10).

They also expressed concerns about the test's effectiveness across all types of TB, noting that understanding its limitations would help them better identify and target the appropriate patients.

"Really, I have not diagnosed many cases with stool, because it is not in routine care… so I cannot know. I can compare […]. Actually, I am not sure if it can do resistance testing […]. Personally, I think GeneXpert still happens to be an easier way, because it deals with sputum […]. It usually detects Rifampicin resistance, so it is still good. So, I don't know much about the stool" (Uganda HCW 8).

Practicality: To what extent can stool-based TB diagnostics be carried out with existing resources?

Although participants did not explicitly discuss their current capacity to implement this intervention in their workplaces (health facilities), their statements suggest that introducing stool-based TB procedures would be challenging with the existing resources. While one HCW noted that there is sufficient staff to meet current TB care demands, others emphasised that without substantial improvements in infrastructure and logistical support, implementing stool-based TB procedures would be extremely difficult in their current settings.

"Yes, we have enough staff […] to work on all those patients. We have staff on day duty, staff on evening, and night duty. There [is] enough staff for all patients at any time. So, in case they are done […]. There are some partners like IDI [infectious Disease Institute] that come in to support us with supplies" (Uganda HCW 1).

"[…] I feel the public healthcare workers are not ready for new challenges or new diagnostic strategies. We once had a problem, and it is still there […], whereby the TB nurses were reluctant to enrol patients into [TB treatment] [especially] patients that were diagnosed using any other sample other than sputum. They had questions about the patients that are diagnosed with urine TB LAM and stool. They [would] ask if we were here to change the guidelines. I feel like the staff members have to be sensitised about the nature of the [lab tests]. Everything should be based on current guidelines because the studies have to improve the guidelines at the end of the day" (Eswatini HCW 3).

HCWs identified significant resource gaps that would challenge immediate implementation using existing resources. Multiple practical barriers were highlighted across infrastructure, timing, and logistics. These included:

Equipment and Supply Requirements

"...From my understanding, it requires new machinery and new equipment. I don't think it is the same machine that is used for sputum. So, the challenges in the future rollout would be the procurement of the equipment for running the samples in government facilities" (Eswatini HCW3).

Timing Challenges

"...Some patients will really be hard to obtain a specimen, a stool sample. Even with that problem, getting a sample on the spot will be a challenge because some people have timely periods of bowel movements. So, it might take longer to diagnose these patients due to delayed sample collection. And then, of course, there will be a challenge of supplies. I do not know what kind of equipment they will use, whether it will be centrifuged, will they use GeneXpert or not?" (Uganda HCW 10).

DISCUSSION

To our knowledge, this is the first study conducted in Uganda and Eswatini to explore HCWs' perspectives on the feasibility and acceptability of stool-based TB diagnostics. Although these are recommended for use as first-line diagnostics in children, and are highly relevant in SSA, where 10% of the global burden of child TB exists, their feasibility remains poorly understood among diverse cadres of HCWs in the regions. Our study provides critical information regarding the experiences and perspectives on the feasibility of stool-based TB diagnostics in HCWs in both Uganda and Eswatini. Our findings indicate that stool-based TB procedures are especially favourable for patients who have difficulty producing sputum, particularly children. This aligns with findings from Mozambique, where HCWs viewed stool-based TB diagnostics as a more advantageous approach, making it suitable for those who struggle most to produce a sputum sample, with a particular emphasis on paediatric populations(12).

Additionally, stool-based TB diagnostics were seen as appealing because they are non-invasive and straightforward compared to sputum-based procedures (such as induction), addressing the needs of both HCWs and patients for an alternative diagnostic method (12). This, in turn, could enhance satisfaction and thus increase acceptability among both groups. Recent studies by KNCV and the European Respiratory Society support this, reporting that a substantial majority of caregivers (75%) preferred stool-based TB diagnostics over standard respiratory sample testing and that laboratory staff found stool-based TB diagnostics to be feasible (20). Our findings suggest that this preference, or demand, may be even greater in situations where conventional diagnostic methods, such as nasopharyngeal and gastric aspiration, require specialised equipment like suction pumps, nasogastric tubes, and nebulisers(21, 22) are unavailable, or when obtaining a quality sputum sample from a patient is not possible.

However, our findings caution that initial demand may be limited, with resistance anticipated particularly among adult patients and some HCWs due to discomfort or aversion to the odour of stool samples, misconceptions, entrenched local beliefs, and the additional travel costs associated with long distances

to health facilities. Supporting this, the latest Global TB Report identifies the costs faced by people with TB and their households as a major barrier to accessing TB diagnosis and treatment, with about 56% of affected households incurring expenses that exceed 20% of their annual income in Africa(2).

Moreover, a study conducted in Mozambique reported that *"feelings of embarrassment or discomfort with a stool request may lead to refusal to provide stool samples, not only because handling stool is perceived as disgusting"* (12). The study also noted that, due to limited awareness of the intervention, both patients and HCWs with existing knowledge of TB as a lung disease may tend to expect and trust respiratory samples over alternative types of samples for TB diagnosis. Even with these challenges, the study suggests that greater dissemination of information and increased familiarity among both patients and HCWs will help to overcome these barriers over time (12).

In addition, our findings indicate that although stool-based TB procedures are already being introduced in some health facilities, their successful implementation may not be feasible under current resource constraints without additional support from external partners and substantial improvements in infrastructure and logistical systems.

The results of this study place greater emphasis on infrastructure requirements than previous literature. For instance, the CDC study reported that laboratory staff found the SOS method comparable to sputum Xpert testing in terms of ease and acceptability (23). However, it did not foreground infrastructure gaps to the same extent as participants in the present study. Our findings, therefore, suggest that implementing stool-based TB diagnostics is not simply a matter of introducing a new clinical test. Rather, it requires a comprehensive, system-wide approach, including upgrading health infrastructure, training all relevant staff, strengthening partnerships with external organisations, and raising awareness among both HCWs and the general public. Our findings also align with existing evidence on pediatric preferences (20) but further suggest that implementation should begin with children and gradually expand to adults, using adapted strategies. Only through such coordinated, multi-level investment can stool-based TB diagnostics be effectively integrated into existing health systems.

Strengths and limitations

Key strengths of this study include the diversity of participants and the cross-country perspectives they provide, enabling a comprehensive qualitative analysis of HCWs' perspectives on the feasibility of stool-based TB diagnostics and informing context-specific implementation strategies. However, several limitations should be acknowledged, including the small sample size, limited geographical representation, the absence of specialised qualitative data analysis software, and financial constraints that prevented returning findings to participants for validation. These limitations may affect the generalizability and transferability of the results, as well as the depth and balance of the conclusions across different participant groups and contexts. Therefore, the results should be interpreted with caution, particularly when making comparisons between countries or demographic groups. Future studies would benefit from larger and more representative samples, the use of qualitative data analysis

software, and the inclusion of a broader range of participants, including caregivers, adolescents, and adult patients, along with participant validation to enhance the credibility of the findings.

CONCLUSION

This study demonstrates that HCWs perceive stool-based TB diagnostics as highly acceptable and particularly suitable for children, offering a non-invasive alternative to challenging sputum collection and aligning with international evidence. However, successful implementation is currently constrained in Uganda and Eswatini due to limited resources. Key barriers include patient reluctance among adults, logistical challenges, and significant infrastructure gaps. These findings indicate that effective integration will require a comprehensive, system-wide approach, including securing external support, upgrading facilities, and implementing multi-level sensitisation programs for both staff and the public, beginning with pediatric populations.

Abbreviations

CDC: *Centers for Disease Control and Prevention*; **COVID-19:** *Coronavirus Disease*; **FGD:** *Focused Group Discussion*; **HCW:** Health Care Worker; **HIV/AIDS:** *Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome*; **NAAT:** *Nucleic Acid Amplification Tests*; **NGO:** *Non- Government Organisation*; **SSA:** *Sub-Saharan África;* **SSI:** *Semi-structured Interview*; **STOOL4TB:** *Evaluation of a new stool-based qPCR for TB diagnosis in children and people living with HIV: a multicentre study in Eswatini, Mozambique, and Uganda*; **TB:** *Tuberculosis*; **WHO:** *World Health Organisation.*

Declarations

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Author's contributions

ALGB, KM, FC, AM, FS, WS, and **AL** wrote the study protocol.

ALGB, WS, SH, AK, MJ, and **KM** acquired the funds.

NKJ, AL, BN, FD, and **FS** contributed to the conception and interpretation of the work.

NKJ, AL, BN, and **FD** wrote the first draft of the manuscript, which all the authors later reviewed.

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Availability of data and materials:

All data relevant to the present study are in the article. The data used for this article are qualitative, with participants sharing personal information that is difficult to anonymise completely. Further, participants have not provided informed consent for their data to be stored in a public repository. Given these reasons and to guarantee confidentiality, we would rather not share our data in a public repository. Data are available from the authors upon reasonable request and with approval from the Stool4TB Steering Committee. The request can be submitted to the coordinator via email: pr.chs@mak.ac.ug.

Ethics approval and Consent to participate

This study was conducted according to the approved protocol, the Declaration of Helsinki, as well as other locally relevant regulations. Ethical approval for this study was granted by the institutional review board of Makerere University Biomedical Research and Ethics Committee (***Ref: SBS-2022-151***) and regulatory approval from the Uganda National Council of Science and Technology (***UNCST Ref: SS1492ES***) in Uganda, whereas in Eswatini, ethical approval was obtained from the Eswatini Health and Human Research Review Board (***EHHRRB026/2025***). Written informed consent was obtained from all participants before interviews. Additionally, the interviews were recorded with the respondent's permission and at the respondent's comfort level. In the event of refusal, the study assistant would continue taking notes during the interviews.

Consent for publication

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The authors declare that they have no competing interests.

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Figures

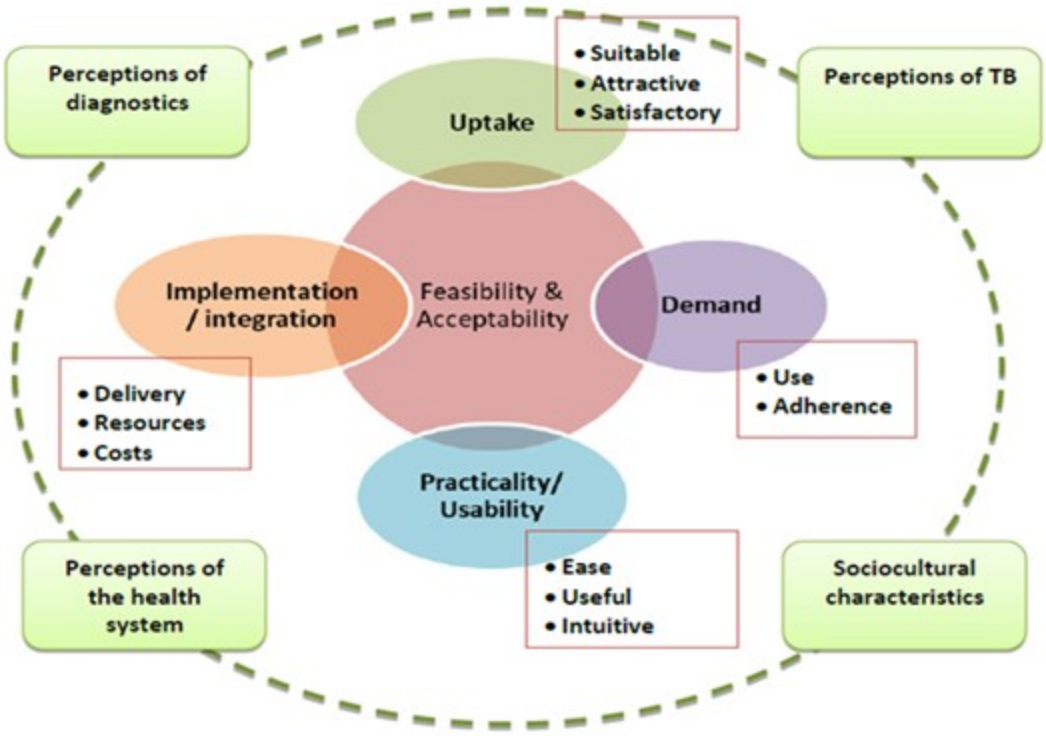


Figure 1

Adapted Conceptual framework on the feasibility and acceptability of stool-based TB diagnostics (16, 20).

Supplementary Files

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