Assessing the fidelity and determinants of implementation: A case of active TB case-finding and IPT initiation among PLHIV attending HIV clinics in Ghana

By

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A THESIS

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Declaration

I, Solomon Ayertey Narh-Bana, having read and understood what the school defined as plagiarism, do solemnly state that this thesis is my work and that I have accredited contributions, outcomes and citations from unpublished and published work of others. This thesis is being submitted for the degree of Doctor of Philosophy in Epidemiology at the University of the Witwatersrand, Johannesburg. This research has not been presented at any other university or used elsewhere.

Signature: 

Date: 08 – 07 - 2022

Dedication

I dedicate this piece of work to my mother, Comfort Maku Tetteh, and the memory of my late father, Nene Awate Bana Atrokpa I, who both contributed richly to my education and instilled in me the spirit of perseverance.

Also, to my wife Diana Esi Narh-Bana for your support, patience and love that saw me through.

Finally, to my kids Joel, Eliana and Odette for their support and enduring my continual absence from home during my study.

God, I am thankful to You.

Original Papers Arising from this PhD Thesis

Four original papers were written as part of this PhD thesis. Out of the four papers, two are currently published, while the other two have been submitted and under review. The first two papers assessed fidelity at provider and facility levels and their moderating factors. The third paper explored barriers and facilitators of implementation. The fourth paper aimed to determine fidelity as a combination of facility and provider level activities of the intervention. The titles of the four articles are listed below and their contents are presented as results in chapters 4 to 7. The original papers have been attached as appendixes A to D.

1. Narh-Bana SA, Kawonga M, Chirwa ED, Ibisomi L, Bonsu F, Chirwa TF (2021) Fidelity of implementation of TB screening guidelines by health providers at selected HIV clinics in Ghana. PLoS ONE 16(9): e0257486. https://doi.org/10.1371/journal.pone.0257486
   Candidate's role: conceptualization, tool development, data collection and analysis, writing the first and subsequent drafts of the paper in light of co-author inputs, and response to reviewers and editor.

2. Narh-Bana SA, Chirwa TF, Chirwa ED, Bonsu F, Ibisomi L, Kawonga M (2021) Adherence of HIV clinics to guidelines for the delivery of TB screening among people living with HIV/AIDS in Ghana. BMC Health Services Research 21:1110 https://doi.org/10.1186/s12913-021-07121-9
   Candidate's role: conceptualization, tool development, data collection and analysis, writing the first and subsequent drafts of the paper in light of co-author inputs, and response to reviewers and editor.

3. Solomon A. Narh-Bana, Mary Kawonga, Selase Adjoa Odopey, Frank Bonsu, Latifat Ibisomi, and Tobias F. Chirwa. Factors influencing the implementation of TB screening among PLHIV in selected HIV clinics in Ghana: a qualitative study (Manuscript accepted for publishing by BMC Health Services Research)

Candidate's role: conceptualization, tool development, data collection and analysis, and manuscript drafting.

4. Narh-Bana SA, Chirwa TF, Chirwa ED, Odopey SA, Bonsu F, Ibisomi L, Kawonga M. Weighted fidelity of delivery of an intervention in the health facility: a case of TB screening among PLHIV in selected hospitals in Ghana (Manuscript submitted – pre-printed and under review)
   Candidate's role: conceptualization, development of tools, data collection and analysis, and manuscript drafting.

Abstract

Background. The World Health Organization (WHO) 2021 global TB report, until the COVID-19 pandemic, reported that TB was above HIV/AIDS as the leading cause of death from a single agent. TB is known to account for about 33% of all deaths associated with HIV. The risk of contracting TB is approximately 10-37 folds higher among PLHIV. Ghana, faced with the TB and HIV epidemic, implemented the WHO's TB/HIV collaborative policy guidelines to lessen the burden of TB among PLHIV. Active TB case-finding through TB screening and Isoniazid Preventive Therapy (IPT) initiation among PLHIV is one essential intervention in the policy.

Since the implementation of the intervention over two decades, screening targets have not been achieved. Information on the coverage of TB screening among PLHIV HIV visiting HIV clinics in Ghana is available. This information indicated that, despite the impact of TB in HIV-positive people, TB screening coverage among HIV clients has been low and fluctuated a few years after the implementation of the TB screening intervention among HIV clients. But there is no information on fidelity and determinants of implementing the intervention of TB screening among PLHIV, which is a crucial factor in determining the success of implementation. If available, information on implementation outcomes such as fidelity (adherence to guidelines), and implementation barriers can help identify the bottlenecks to successful implementation, and inform strategies for improving implementation processes and outcomes to achieve successful intervention outcomes.

Therefore, this PhD thesis aims to 1) assess the fidelity of the active TB case-finding through TB screening IPT initiation intervention among PLHIV attending HIV clinics in Ghana, and 2) explore implementation determinants of the TB screening intervention among PLHIV attending HIV clinics in Ghana. This is to provide context-relevant evidence that could inform the design of appropriate implementation strategies for supporting or strengthening implementation efforts in Ghana. The specific objectives included: determining the provider level fidelity to clinical protocols of the intervention; evaluating the influence of moderating factors on provider fidelity of the intervention; determining the facility level fidelity to the intervention; comparing the moderating factors by facility level; determine an overall implementation fidelity using a composite of provider and facility level guidelines of the intervention, and exploring the determinants of implementation of the intervention among PLHIV attending HIV care clinics in Ghana.

Methods. The research was cross-sectional and explorative, conducted in 27 selected district hospitals with HIV or ART centres in Ghana. These 27 hospitals were purposively selected because, in the year 2018, they were identified to have started the initiation of IPT among HIV clients who have been confirmed of not having TB in Ghana. Fidelity was assessed at the provider, facility and combined levels. Items in the guideline related to the providers were grouped into three components (TB diagnosis – 10, TB awareness – 4, TB symptoms questionnaire – 2 items). At the facility level, the items were grouped into four components - intensive TB case-finding among PLHIV (ITCF) 5 items, IPT initiation (IPT) 3 items, TB infection control (TIC) 5 items and programme review meeting (PRM) 5 items. A summation of items score was used to determine fidelity scores. A computed median fidelity score was used in this study as the cut-off point due to lack of reference for determining what constituted a high-level fidelity or a low-level fidelity. Opportunity-based weighting approach was used to assess the combined fidelity. In addition, we conducted Focus Group Discussions (FGD) and Indepth Interviews (IDIs) to explore the determinants of implementation of the intervention.

Results. A total of 226 HIV healthcare providers and 27 facility managers were interviewed. Also, 8 FGDs with HIV healthcare providers and 17 IDIs with TB/HIV coordinators were conducted.

At the provider level, 60% (135) of the HIV healthcare provider were females, and their mean age was 34.5 years (SD=8.3). Majority were clinicians [63% (142)] and had obtained post-secondary non-tertiary educational level [62% (141)]. The proportion of the healthcare providers categorized to have implemented the intervention with high fidelity was 53% (119). Also, 56% (126), 53% (120), and 59% (134) of them implemented the TB diagnosis, TB awareness and TB symptoms questionnaire components, respectively, with high fidelity., Female healthcare providers (AOR=2.36, 95%CI: 1.09–5.10, p=<0.029), those with tertiary education (AOR=4.31, 95%CI: 2.12–9.10, p=0.040), and clinicians (AOR=1.78, 95%CI: 1.07–3.50, p=0.045) were more likely to adhere to the guidelines compared to their counterparts, after adjusting for the clinic as cluster effect.

At the **facility** level, the median adherence score for ITCF component was 85.7% (IQR: 85.5-100.0), for IPT was 0% (IQR: 0-66.7), for TIC was 33.3% (IQR: 33.3-50.0), and for PRM components it was 90.0% (IQR: 70.0-90.0. Overall, the median adherence score for the facility was 62.1% (IQR: 58.6-65.1), with 17 clinics (63%) scoring above the median, categorized as

high adherence. High adherence facilities had statistically significant lower PLHIV clinic attendees per month (256 (IQR: 60-904) than low adherence facilities 900 (IQR: 609-2622); p=0.042), and lower HIV provider workloads (28.6 (IQR: 8.6-113) than low adherence facilities 90 (IQR: 66.7-263.5); p=0.046). The high adherence facilities had most of the screening guidelines (76%, p<0.01) and questionnaire (80%, p<0.01) available on-site.

Also, at the combined level, the weighted fidelity median score was 67% (IQR: 59.9 – 74.9%), and the TB screening coverage was 71.3% (IQR: 56.9 – 96.7). The weighted fidelity of delivery is statistically associated with TB screening coverage (p<0.01). Facilities with TB IE&C materials available had significantly (p=0.025) higher median fidelity score (75.4% (74.9 – 88.5)) than their counterparts (65.7 (59.4 – 72.6)). All the other moderating factors investigated have no statistical association with weighted fidelity of delivery (p>0.05) except IE&C.

Participants in the qualitative study (phase 2) recognised TB screening as an essential intervention to decrease TB's burden among PLHIV. In addition, ease in TB screening for PLHIV, existing good communication and referral systems, effective goals setting and feedback mechanisms, good recognition for the need of the intervention by HIV healthcare providers, and the role played by existing chemical sellers were indicated by the HIV healthcare workers and coordinators as the main facilitators that promote the implementation of the TB screening among PLHIV.

The study also identified factors such as high workload, no transportation, nature of the disease, non-reimbursement of ancillary cost, lack of staff, no staff motivation, no in-service training, old infrastructures, lack of privacy and space, inadequate resources (laboratory), non-availability of enablers for clients and health works were also identified by the participant main barriers hindering the TB screening implementation among PLHIV attending HV clinics.

Conclusion. The study assessed fidelity of delivery at the different levels of health delivery, their related factors and determinants of implementation of TB screening at the HIV or ART clinics. Combined provider-facility fidelity was revealed as a practical approach to assessing implementation fidelity at the health facility. The separate fidelities showed the extent of implementation of the intervention guidelines as planned at the various levels. Hence, variations observed in the fidelity levels and related factors needed further investigation. The findings are critical in the wake of the rising public health importance of the double burden of TB and HIV in low- to middle-income countries like Ghana.

Implementation of TB screening is critical in PLHIV in Ghana. Programme managers, facility managers and TB/HIV coordinators should be devoted to ensuring HIV healthcare workers have regular in-service training, motivated through reimbursement of intervention-related costs and the provision of adequate space and privacy to ensure successful implementation of TB screening amongst HIV clients. Participants, especially HIV healthcare providers have accepted the intervention and therefore used the ease of the TB screening tool, feedback and supervision and their good network and communication to promote the implementation of the TB screening intervention among PLHIV attending HIV clinics.

Hence, knowledge of fidelity and both facilitators and barriers of implementation, and how to address them can inform the planning and implementation of the TB screening in HIV clinics and ART centres in Ghana and similar contexts across low- and middle-income countries worldwide.

Key Contribution. Most fidelity assessments were done at the provider level, however, this PhD has added fidelity assessment at the programme or facility level and especially combined facility-provider level which is missing in the implementation literature. Hence, it is an extension of knowledge and methodological innovation in implementation science. In addition, this study has demonstrated how to categorise fidelity into high or low fidelity.

This research reveals where efforts can be targeted to improve implementation fidelity to increase and achieve targets of TB screening coverage among PLHIV in Ghana. In addition, it showed the barriers to be addressed by the National TB Control Programme to ensure successful implementation of the intervention in Ghana.

Keywords: TB, Facility adherence, provider adherence, TB screening factors, IPT, implementation determinants, PLHIV, HIV clinics, composite, weighted fidelity, implementation fidelity levels, healthcare providers, implementation science, Ghana, sub-Saharan Africa

Acknowledgements

".... Be thankful to Him,

And bless His Name.

For the Lord is good;"

Psalms 100: 4 - 5

I hereby show my appreciation to my Supervisors, Professor Tobias F Chirwa, Dr Mary Kawonga and Prof Frank Bonsu, for their unending support, inspiration and supervision during the period I embarked on my PhD and most importantly for their directions and contributions to the different phases of this research work throughout.

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List of Abbreviations/Acronyms

AIDS	-	Acquired Immune Deficiency Syndrome
ART	-	Antiretroviral Therapy
CFIF	-	Conceptual Framework for Implementation Fidelity
CFIR	-	Consolidated Framework for Implementation Research
CXR	-	Chest X-ray
DHs	-	District hospitals
GHS	-	Ghana Health Service
HIV	-	Human Immunodeficiency Virus
IPT	-	Isoniazid Preventive Therapy
IQR	-	Interquartile range
IS	-	Implementation Science
ITCF	-	Intensive TB case-finding among PLHIV
MOH	-	Ministry of Health
NACP	-	National AIDS/STI Control Programme
NTP	-	National Tuberculosis Control Programme
PCA	-	Principal component analysis
PLHIV	-	People living with HIV
PRM	-	Programme review meeting
TB	-	Tuberculosis
TIC	-	TB infection control
WHO	-	World Health Organization

Definitions of Terms

- ***Implementation:*** Carrying out an evidence-based intervention under real-life conditions and making it part of the everyday practice
- ***Implementation Outcomes:*** The effects of deliberate and purposive actions to implement TB screening and initiating IPT in HIV care clinics in Ghana. Among the eight implementation outcomes is fidelity to the intervention guidelines.
- ***Fidelity:*** The degree or extent to which the TB screening and IPT initiation had been implemented at the facility as prescribed in the NTP guidelines.
- ***Facility (programme) level fidelity****:* The level at which programme guidelines for implementing the intervention are being implemented by the facility as planned by the NTP. The term programme level and facility level are used interchangeably for the purpose of this study to mean the same.
- ***Provider level fidelity****:* The level at which clinical protocol guidelines for implementing the intervention are being delivered by HIV healthcare providers as the NTP planned it.
- ***Determinants of implementation:*** Barriers and facilitators during the implementation of the TB screening at the HIV clinic

1.0 Introduction

1.1 Thesis Overview and structure

This thesis is submitted using the divided block format. Each paper produced from this study represents a different results chapter. It also includes an Introduction, Literature Review, Methods and Conclusion as separate chapters. The thesis is organized and divided into eight (8) chapters explained below:

Chapter 1 Introduction

The introduction to this thesis is presented in this chapter. The chapter further presents a brief background to the study, discusses the study's rationale, explains the aims and objectives, and offers a general overview of how the thesis is structured.

Chapter 2 Literature review

We present under this chapter a brief review of the global burden of TB among PLHIV, followed by the burden in sub-Saharan Africa. The TB situation in Ghana follows, which comprises a brief on Ghana's demographic and socio information, the health structure of Ghana, the burden of TB in Ghana, and the TB/HIV collaboration in Ghana. Next, the assessment of implementation fidelity, fidelity levels and factors influencing implementation of an intervention in health facilities are discussed. The last sub-section discusses the conceptual framework that directed the conduct of the study.

Chapter 3 Methods

Chapter 3 provides a synthesis of the methods used for the study. Methods discussed under this section include; the design of the study, the setting where the study was conducted, the study population and sampling approaches used. In addition, we discussed briefly the data sources, the study's conduct and procedures, and the data analysis method employed. Detailed methods are described in each of the four papers representing the four different result sections under

chapters 4 to 7, of which the PhD student is the first author. This chapter also describes all the ethical issues of the study.

Chapter 4 Results – Understanding provider-level fidelity to the intervention

The fourth chapter presents the paper produced to address objectives 1 and 2 of the thesis. It evaluates the provider level implementation fidelity to the TB screening intervention and it's relating factors.

Chapter 5 Results – Understanding facility-level fidelity to the intervention

This chapter presents the second paper produced from this thesis. It emanated from objectives 3 and 4 of the study, focusing on assessing facility-level fidelity to the implementation guidelines and its related factors in Ghana.

Chapter 6 Results – Understanding implementation determinants to the intervention

We present the third paper that sought to understand the barriers and facilitators to implementing the intervention. This paper covers objective 6 of the study, and it is purely qualitative.

Chapter 7 Results – Understanding combined facility-provider fidelity to the intervention

The seventh chapter presents the fourth paper, which addresses the extent to which the facility as a whole implemented the intervention. The paper combined the guidelines for the facility and HIV healthcare providers to ascertain a combined fidelity level of delivery of the intervention. This paper covers objective 5 of the study.

Chapter 8 General discussion and conclusion

In this ending chapter, the significance of the findings are highlighted considering what is already known and their implications for policy and practice. Additionally, it discusses the

contributions of this thesis to literature, outlines limitations of the research, and lessons learnt along with general conclusions drawn from the study.

1.2 Background

The Global Tuberculosis Report, 2014 indicated the number of people infected with tuberculosis (TB) was 9 million in 2013, out of which 1.5 million people died; about 24% of this number were people with HIV. Globally, TB, although curable, is known to kill about 500 people daily and is the main cause of morbidity and mortality amongst people living with HIV/AIDS (PLHIV). According to the World Health Organization (WHO) 2017 TB report globally, TB accounted for about one-third of all deaths associated with HIV (1,2). In addition, the risk of contracting TB is approximately 10-37 folds higher among people living with HIV than those without HIV (3–5).

In sub-Saharan Africa, the issue of TB and HIV co-infection is of great concern. Of the 22 sub-Saharan African countries that have the burden of TB, nine countries contribute to the highest-burden of TB globally (6). According to the WHO, the high prevalence of HIV and its spread within this region drive the incidence of TB. Also, in 2016 about 34% of PLHIV were diagnosed with TB. In 2014, the WHO reported an estimate of 1.1 million TB patients were co-infected with HIV (7). Most of these sub-Saharan African countries are within the low to middle-income class, facing resource constraints (8) but have to take action to attain a range of TB related Sustainable Development Goal (SDG) targets. For instance, Ghana, one of the middle-income countries, has an HIV prevalence of 1.6% (7) and an estimated 224,488 persons, made up of 34,557 (11.8%) children having HIV and AIDS. The TB and HIV co-infection prevalence in Ghana is at 14.7% (9).

Effective TB control strategies are contingent on treating those who tested positive and preventing those who tested negative from contracting the disease. Tuberculosis can best be controlled by early detection through active case finding and appropriate treatment. Active TB case finding among contacts of TB and HIV patients through simple interventions such as outreach TB screening or screening of all HIV patients for TB at HIV care clinics have been used (10). Mhimbira et al. (11) conducted a review to assess the effectiveness of diverse innovations to improve the detection of TB at a significantly lower level of healthcare services. They found that outreach TB screening increased TB case detection from 24% to 52%.

However, they deduced that this strategy had little or no effect on treatment compared to screening at HIV care clinics.

On the other hand, according to Date et al. (12), TB screening among PLHIV improves the probability of survival, quality of life, and lessens the spread of tuberculosis in an area. It also increases the chances of putting HIV clients who show no active TB on Isoniazid Preventive Treatment (IPT) for latent TB infection (5,6,13). IPT is a preventive therapy given to HIV clients who do not have active TB. Its effect is known to supplement the impact of ART on reducing the infection of TB.

In 2004, the WHO instituted a TB/HIV collaborative policy guideline to control the TB/HIV epidemic (1,7). Amongst the goals of the TB/HIV joint activities is to lessen the trouble of TB in PLHIV (14). The intervention activities for this goal were intensified TB case-finding through screening for TB, ensuring that HIV clients who screened negative for TB are initiated on Isoniazid preventive therapy (IPT), and ensuring the control of TB in all health facilities (14). In addition, high-quality anti-tuberculosis treatment is given to PLHIV, who have a confirmed diagnosis of active TB. Many countries where TB/HIV co-infection were of public health concern, including Ghana, adopted and implemented this policy intervention, as recommended by the WHO (15).

Despite evidence that this TB/HIV control intervention has the potential of reducing the burden of TB in PLHIV, progress on IPT implementation worldwide has been slow and unable to achieve and sustain desired results (16). Globally, about one-third of HIV positive-tested clients are screened for TB at HIV care clinics (16–18), contrary to the policy, and only 17% of HIV positive adults screened negative for TB are put on IPT (16). Despite the immense challenge posed by the TB/HIV diseases to healthcare systems in sub-Saharan Africa, only 9% of PLHIV had been screened actively for TB, out of which only 3% were put on IPT (19). Therefore, the existence of intervention of known efficacy is not enough to ensure their implementation. Implementation is a way of carrying out an evidence-based intervention under real-life conditions and making it part of everyday practise (20,21). Therefore, implementation is critical in achieving and sustaining the desired result of health interventions.

The definition of implementation science (IS) by the National Institutes of Health (NIH), as *"the study of methods to promote the integration of research findings and evidence into healthcare policy and practice"*, makes an essential contribution to understanding implementation processes and barriers, and developing strategies to improve implementation

outcomes (21). Various implementation outcomes (or implementation quality constructs) are known to influence the effectiveness of an intervention (22). Implementation of intervention with high quality is expected to yield the desired programme and clinical outcomes (16). Implementation outcomes commonly discussed in the IS literature include, fidelity (whether the implementation was implemented as planned), reach (whether it reached the intended audience) and acceptability (whether it was acceptable to implementers and recipients) (21)

1.3 Rationale of the study

Ghana's TB/HIV policy goals were to reinforce the health system to act in response to the TB and HIV epidemic, lessen the catastrophe of TB amid PLHIV and lessen the catastrophe of HIV among TB patients. Each of the goals has specific collaborative activities. For instance, to reduce or lessen the burden of TB in PLHIV, joint activities including TB prevention and infection control among PLHIV, timely diagnosis and treatment of HIV clients among TB patients, and prevention of TB disease in HIV clients were in place. Effective TB control strategies for minimising the burden of TB are through early detection, then prevention of TB among PLHIV. The study's intervention of interest and focus was the TB burden reduction through TB screening in PLHIV visiting HIV or ART clinics in Ghana.

Ghana initially implemented the intervention to lessen the burden of TB in PLHIV over a decade ago, and the IPT component was supposed to have been added in 2018 (23). A review of literature on program indicators for Ghana shows that during the early stages from 2008 to 2012 of the implementation of the TB screening intervention, a high proportion of PLHIV (70% – 96%) were screened for TB at HIV care (24). Unfortunately, this observed success has not been sustained as programme data further revealed that in the years 2013 and 2014, approximately 80% (24) and 41% (25) of PLHIV, respectively, were not screened for TB as part of care contrary to the TB/HIV collaborative guidelines. In 2014, the policy, as a result, was revised with different TB screening coverage goals set at 56% for 2015, 64% for 2016, 70% for 2017, 80% for 2018, 85% for 2019, and increased to 90% in 2020 (24). The reason for such slow and fluctuating progress is unknown since no research has been conducted to that effect.

Achieving the set targets will require full implementation of the intervention. If the intervention is implemented partially, it might affect the set targets and have a limited impact on curbing

the dual TB and HIV epidemic (16). It has been shown that the degree of how well an intervention is implemented can determine its potential impact (26). Furthermore, digression from the implementation policy may be counter-productive and lead to a waste of resources to the country. Although the information on the TB screening coverage among HIV clients visiting the ART clinics in Ghana is available, information on how well the intervention is being implemented and the determinants of implementation are not readily available in Ghana. The availability of such information will be useful in identifying and addressing gaps and bottlenecks to improve implementation outcomes in later years to achieve set targets of the intervention outcomes.

A review by Proctor et al. (2010) set clarity on the taxonomy of the eight implementation outcomes and their measurement and the salient stage at which each implementation outcome could be assessed (21). Most of the intervention components of interest in this study have been implemented for over a decade now. Therefore, the choice of evaluating fidelity for this study is appropriate because it agrees with what Proctor et al. proposed as an implementation outcome to be assessed at mid to later stages of the intervention (21). Fidelity to an intervention and factors that influence implementation is essential and critical implementation issues worth considering, especially when the intervention is not yielding expected results (27–29).

Also, the most significant gap in the IS literature is how we measure fidelity, factors that influence fidelity in different contexts, and the mechanisms through which these factors influence fidelity. To address some of the gaps in IS, there is the need to assess how well the TB prevention intervention is being implemented and investigate the determinants of implementation to establish the barriers and facilitators of the implementation. The implementation outcome to be researched is fidelity at the provider and the facility levels.

To minimize the problem of TB amongst PLHIV, the operational strategies of the TB/HIV collaboration programme need to be implemented at HIV care clinics according to the policy guidelines. Likewise, the providers have a role in implementing the interventions as intended in the guidelines—the healthcare providers work in health facilities. The health facilities are the district hospitals within which the HIV care clinics are located. However, the literature on fidelity often describes either provider or programme (facility) level fidelity separately. However, this PhD study argued and concentrated on the complementary roles of the health facility and the providers in implementing the intervention that can influence the outcomes. In the health system, the facility level is where intervention programmes are operationalized. The

intervention at this level is implemented by the facility operational managers and respective healthcare workers. The facility is therefore a good representative of the programme activities. Information on how well the facility and providers undertake their roles is crucial, but such is not available.

WHO has recommended TB screening among PLHIV as a critical component of the intervention package of HIV care due to the high susceptibility of the PLHIV to TB and the spillover effect on the non-HIV families and community members. The study, therefore, aimed to assess implementation fidelity and implementation determinants of TB screening amongst PLHIV visiting the HIV clinics in Ghana. Combined fidelity was evaluated at both provider and programme (facility) levels for 27 district hospitals across Ghana. In addition, barriers and facilitators of the intervention to improving TB/HIV programme performance and reducing the problem of TB in PLHIV in Ghana were explored.

The study makes a methodological contribution to measuring fidelity in health at a health facility where intervention is implemented. It also provided helpful information to link TB programme outcomes, such as TB screening coverage and the proportion initiated on IPT during the intervention (20,30).

1.4 Aim and objectives of the study

1.4.1 General aim of the study

To assess the fidelity and determinants of the implementation of the TB screening intervention among PLHIV visiting HIV and ART care clinics in Ghana. The TB screening is the key intervention activity for the active TB case-finding and IPT initiation policy. In addition, the TB screening among PLHIV is a critical intervention component of the HIV care package due to its potential impact on reducing the TB burden.

1.4.2 Specific objectives

1. To determine the provider level fidelity to clinical protocols of the intervention among PLHIV attending HIV care clinics in Ghana.

2. To evaluate the influence of moderating factors on provider fidelity of the intervention among PLHIV attending HIV care clinics in Ghana.

3. To determine the facility level fidelity to the intervention guidelines among PLHIV attending HIV care clinics in Ghana.

4. To compare the moderating factors by facility level fidelity of the intervention among PLHIV attending HIV care clinics in Ghana.

5. To determine an overall implementation fidelity using a composite of provider and facility level guidelines of the intervention among PLHIV attending HIV care clinics in Ghana.

6. To explore the determinants of implementation of the intervention among PLHIV attending HIV care clinics in Ghana.

1.5 Thesis framework

This PhD research includes both provider and facility level analyses, as shown in Figure 1 below. The providers implement an intervention within health facilities; however, interventions in the health facilities are executed from the facility levels cascading down to the provider level. Therefore, guidelines of the implementation of the intervention operate hand in hand to achieve results.

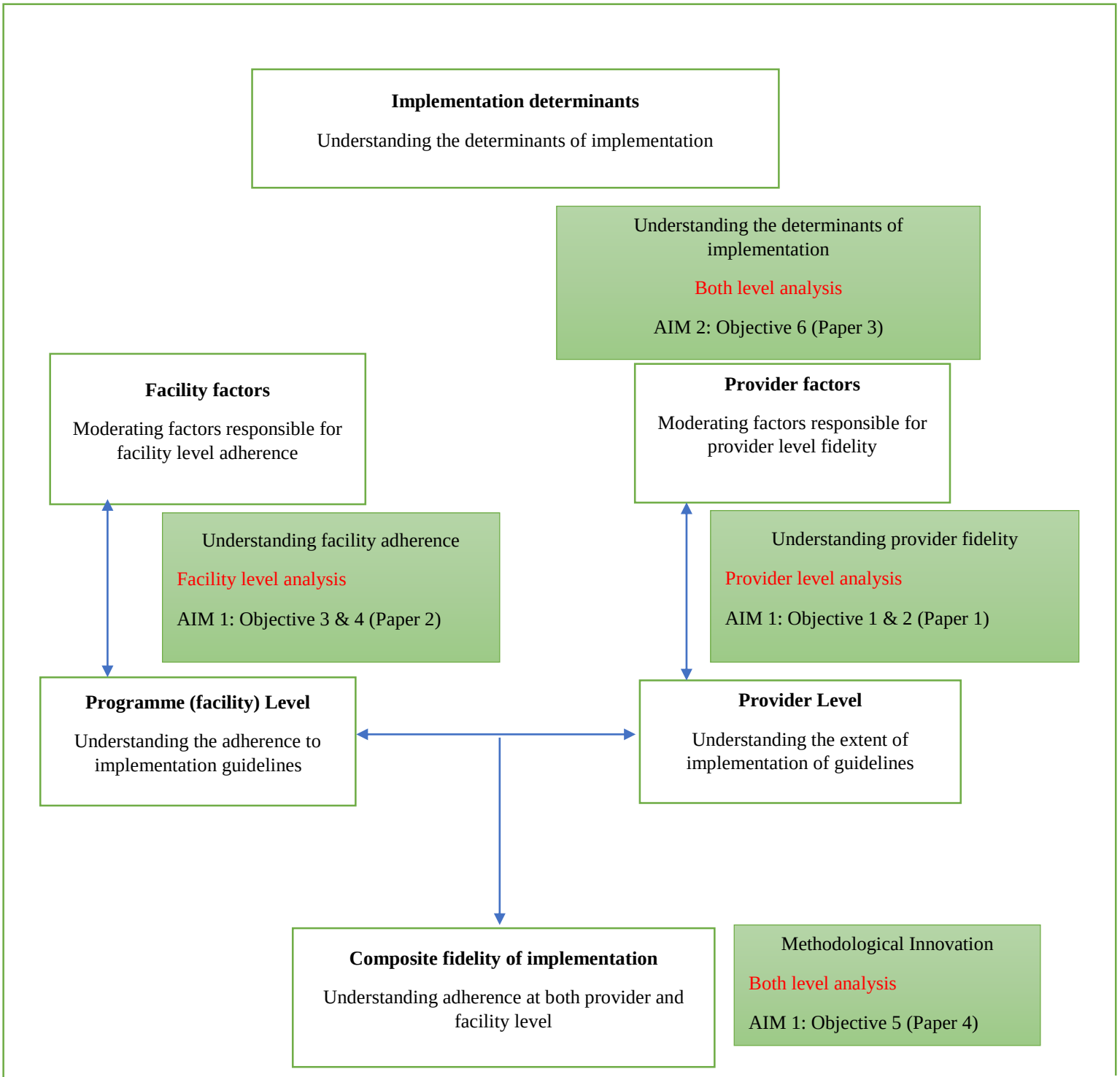


Figure 1: Thesis framework linking the research objectives to the papers

This section ends chapter 1 of the thesis. The next chapter offers a well-organised review of existing literature mostly related to the focus of the study.

2.0 Literature Review

This chapter contains seven main sub-sections of reviewed literature. It starts with information on Ghana's demographic, socio-economic, and health service structure. It continued with a literature review on the global TB burden, followed by sub-Saharan Africa and Ghana's TB burden. After which, a review on fidelity levels of intervention, determinants of implementation in health and TB screening among PLHIV. Finally, the section ends with information on the frameworks adapted for conducting the study.

2.1 The economy and health service structure of Ghana

2.1.1 Demographic and socio-economic information

Ghana is a sub-Saharan African and a lower-income developing country found alongside the Gulf of Guinea and the Atlantic Ocean in the West Africa sub-region. Ghana covers 238,535 km2 and is bordered in the west with Ivory Coast, east with Togo, north with Burkina Faso, and with Gulf of Guinea and the Atlantic Ocean in the south (31). There are ten subnational government administrations known as regions within Ghana when planning the study. For local governance, there were further 216 administrative subdivisions of the regions called districts in 2017. This number has grown by splitting into 260 districts in 2018 and 2019. These districts are made up of ordinary, municipal and metropolitan. As shown in Figure 2 below, the ten regions were further regrouped into three ecological zones, namely Savannah, Forest and Coastal zones (32).

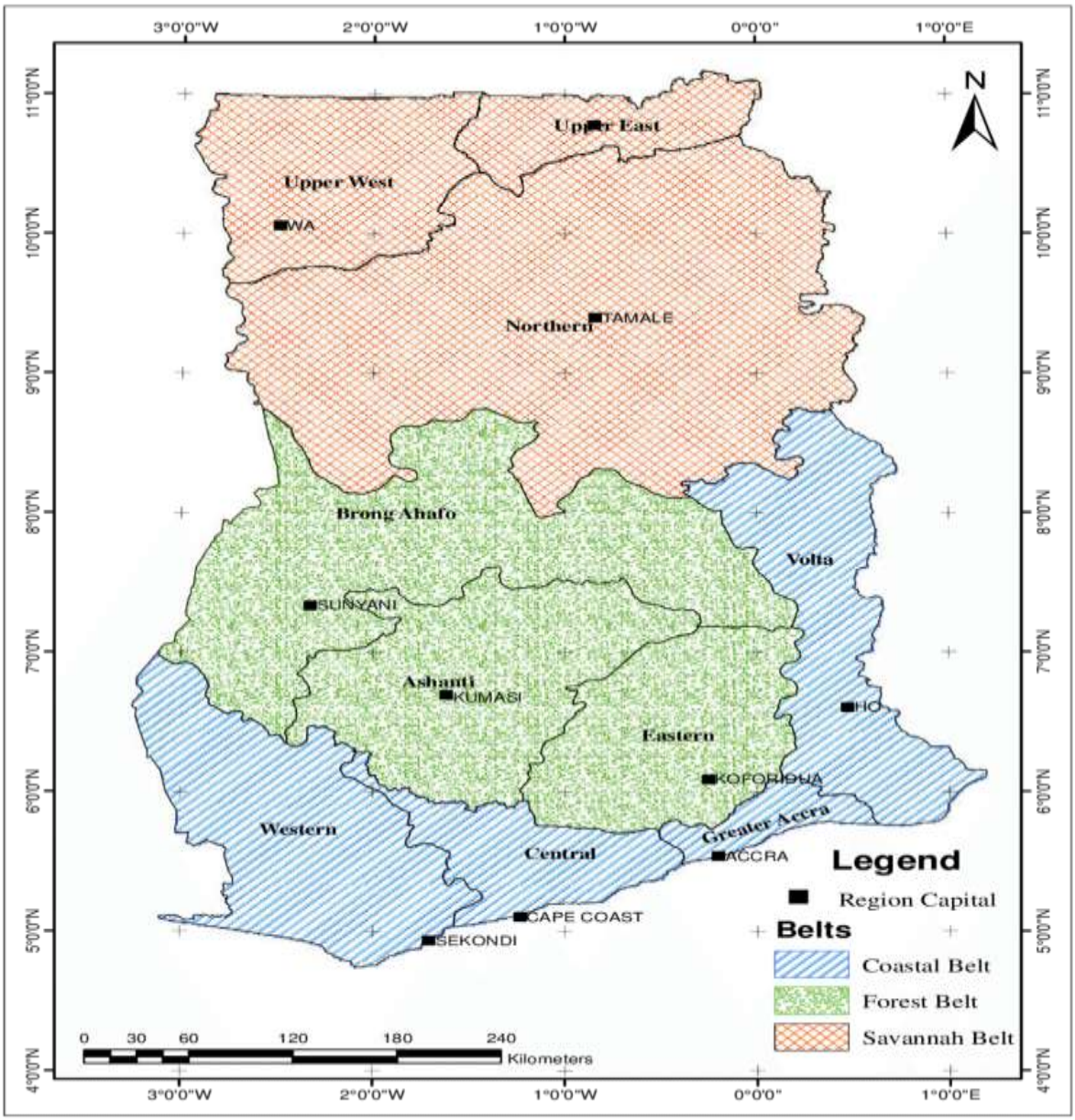


Figure 2: Map of Ghana showing the 10 regions and 3 ecological belts (32)

It is estimated as of 2019 that Ghana has a mid-year population of 30,083,000, of which 29% were less than 15 years of age and 57.9% were between 15–64 years (31). However, the 2010 census in Ghana showed that most (71.2%) people were Christian, followed by Muslim (17.6%), and then the traditionalist (5.2%). The country has over seventy ethnic groups, with the populous groups being the Akans (47.5%), the Mole-Dagbon (16.6%), the Ewe (13.9%), the Ga-Dangme (7.4%), the Gurma (5.7%), the Guan (3.7%), the Grusi (2.5%), the Kusaasi (1.2%), and the Bikpakpaam also known as Konkomba (3.5%) (31).

Starting 2018, the country had an annual population growth rate of 2.16%, a birthrate of 30.2 births per 1,000 population, a rate of death at 6.8 deaths per 1,000 population. In the same period, the fertility rate was 3.96 children born per woman, the infant mortality rate was 39.01 deaths per 1,000 live births, the contraceptive prevalence rate was 33%, and a life expectancy was 67.4 years (33).

Ghana's economy has various rich resource bases. These consist the manufacturing and exporting materials such as hydrocarbons industrial minerals. In addition, Ghana is the second-biggest producer of gold (after South Africa) and the second-largest producer of cocoa in Africa. Ghana currently has a nominal GDP of $67.077 billion and an inflation rate of 9.2% (2020 estimates) (33). Government total health expenditure for the year 2016 was 4.4% of GDP while 37.8% of total health expenditure for the same year was from out-of-pocket of the individuals (34). In 2015, Global Fund signed a grant of US$ 248 million for Ghana to increase substantially the number of people receiving prevention, treatment and care for TB, HIV and malaria (35).

With Ghana's universal health care system available, more than 12 million Ghanaians have enrolled in the National Health Insurance Scheme by 2019 (36).

2.1.2 The health service structure of Ghana

The Ghana Health Service (GHS) is the mandatory institution responsible for healthcare provision and delivery in Ghana (37). The GHS is a Ghanaian government body established under the GHS and Teaching Hospitals Act 1996 as part of Ghana's Health Sector Reform and Medium Term Health Strategy and a distinct entity under the Ministry of Health (37). This distinctiveness made GHS different and not part of the overall Civil Service of Ghana. The Ministry of Health is in charge of policy formulation and enactment, while GHS is responsible for service provision.

There are different levels of management teams under the GHS spanning from the regionals through districts to facilities. The team is made of a different calibre of health personnel headed by a substantive head of the respective institutions at each level. Consequently, the teams also vary considerably across regions, districts and facilities.

The health delivery system has different levels of facilities: health posts, health centres and clinics, district hospitals, regional hospitals, and tertiary hospitals (38,39). In 2017, there were ten administrative regions with 216 subdivisions called districts. At the district level, each is expected to have a functioning hospital known as the district hospital owned by the government of Ghana. So far, of the 216 districts, 140 of them have functioning district hospitals in 2017 (source: Ghana Health Service, DHIMS2) (38). The district hospitals are the highest facilities for clinical care serving a population between 100,000 to 200,000, with usually about 50 to 60 beds. In addition, they provide curative care, health promotion activities, and preventive care to the people and serve as referral points from health centres and polyclinics around its catchment areas. Treatment techniques involving surgery, laboratory, and other diagnostic techniques are performed at the district hospital. They run both out-patient and in-patient services.

Healthcare provision is administered mainly by state-owned facilities, which form about 61% of total health facilities, with private facilities making 31% and faith-based health facilities making up the remaining 7% (38,39). Since 2003, the country had a universal health care system after the introduction of the National Health Insurance Scheme (NHIS) under the management of the Ghana National Health Insurance Authority (NHIA) (40).

2.2 The global burden of TB among PLHIV

Tuberculosis (TB) disease is a key cause of illness and among the top 10 causes of mortality worldwide. Since 2007, it has been ranked above HIV/AIDS, a disease with the primary cause of mortality from a distinct infectious agent (41,42). Globally, TB occurs in all parts of the world and affects all age groups (42). In 2018, about 10 million people were estimated to have contracted tuberculosis(TB) globally, with men being the most affected (5.7 million), followed by women (3.2 million) and children (1.1 million) (41,42). Also, about a quarter of the global population has latent TB, and between 10-15% of these will progress to active TB disease over their overtime (42,43).

Of the total global TB problem, 87% of new cases were accounted for by eight nations in 2018. India recorded the maximum number of new cases, while China, Indonesia, the Philippines, Pakistan, Nigeria, Bangladesh, and South Africa followed (41,42). Everyone is at risk of

contracting TB; however, adults in their productive years are primarily affected, and most (95%) of these cases and deaths occur in developing countries (41,42).

Among all the TB infected persons, 8.6% are living with HIV (41), and TB is also the dominantly presenting illness among people living with HIV (44). People living with HIV are between 15 and 22 times more likely to get TB than those without HIV(3,4,44). TB is also causing more deaths among HIV infected people, with a quarter of all TB deaths being HIV related (41,44). In 2018, for example, about 16% (251 000) of all TB deaths occurred in persons living with HIV (42). Although this was a 60% reduction from 620 000 in 2000 (41), the current number is relatively high. According to the Global Fund report (2019) on assessment and best practices for the application of TB and HIV activities jointly, TB screening among PLHIV and ITP initiation coverage amongst people living with HIV (PLHIV) have been below targets over many years (45).

In terms of spatial distribution, sub-Saharan Africa had the most problem of TB/HIV comorbidity, with approximately 84% of all TB/HIV deaths in 2018 borne by the region (44). Also, considering the distribution of TB/HIV deaths by African sub-regions, with the exception of Northern Africa, all the other sub-regions continued to increase the incidence of TB/HIV deaths over time (46).

TB is a treatable, curable, and preventable disease (42,47); consequently, between 2000 and 2018, over 58 million lives were saved as a result of timely TB diagnosis and treatment (47). In 2016 alone, 83% of people were newly diagnosed with TB, and 54% of multidrug-resistant (MDR-TB) patients globally were successfully treated (47). Prominent global targets and milestones for reducing TB burden include Sustainable Development Goals (SDGs) (48) and the End TB Strategy by WHO (49). The third SDG goal consists of ending the global TB epidemic by 2030 (41,48). The End TB Strategy comprises set targets at 90% drop in TB deaths and an 80% drop in the TB incidence rate between 2015 and 2030; meanwhile, in 2020, a 35% decrease in TB deaths and a 20% decrease in TB incidence rates (41,49) were expected. However, the 2019 WHO report on TB indicated that most countries and regions with high TB issues were not in the position of attaining the 2020 End TB Strategy milestones (41). Universally, the TB incidence rate annually had declined by 1.6% from 2000 to 2018, with a cumulative decrease of only 6.3% between 2015 and 2018 (41). The worldwide decline in mortalities associated with TB was 11% between 2015 and 2018 (41). However, concerning

the WHO Africa region, there have been a 12% drop in TB incidence and a 16% drop in TB deaths between 2015 and 2018 (41).

To reach the milestone of End to TB strategy or achieve the TB screening targets towards lessening the burden of TB globally, the extent to which the implementers implement the intervention needs assessment in furtherance of linking outcomes effectively to the intervention.

2.3 The burden of TB among PLHIV in sub-Saharan Africa

The sub-Saharan Africa region is known to have the highest burden of both HIV and TB infection (50). Whiles accounting for only 12% of the global population, sub-Saharan Africa (SSA) accounted for 68% of the global HIV prevalence in 2010, with South Africa and Nigeria leading the count (51). Also, nine countries in sub-Saharan Africa were part of the 22 countries with the high burden of TB globally (52). Such countries included and in no particular order the Democratic Republic of Congo, Kenya, Ethiopia, Mozambique, Nigeria, South Africa, Uganda, Tanzania and Zimbabwe (52). Still, in SSA, about 33% of the people have latent TB infection (53), with a 10% chance for the immune-competent individuals to develop active TB and a 50% chance for those infected with HIV to advance to active TB later in life (54). The primary cause for the reappearance of TB in Africa is the relationship between TB and (HIV/AIDS) infection (55). The risk of dormant Mycobacterium TB advancing to active TB in HIV clients immunologically deficient is high (55). Compared with those not infected, the comparative risk of TB incidence among people infected with HIV is from 20 to 37 folds, subject to the stage of the HIV disease (52,56).

According to the WHO tuberculosis report (2011), approximately 39% of all new TB infections in sub-Saharan Africa were attributable to HIV, while the global rate for the same variable was only 13% (52). In 2010, 82% of the global PLHIV incident TB cases were recorded in the WHO Africa region (51). In 2014, about 1.2 million people living with HIV worldwide developed tuberculosis, and 74% resided in sub-Saharan Africa (56). Also, half the number of people with TB in sub-Saharan Africa are infected with HIV (41). HIV and TB co-infection are characterised by high mortality rates globally (50), with TB standing out as the leading cause of death among people living with HIV (56). For example, in 2010, for instance, of about 1.40 million deaths from TB globally, 25% were attributable to HIV, representing a 13

percentage point increase from 12% in 2000 (52). Concerning TB mortality, about 390,000 people lose their lives from HIV-associated TB globally in 2014, representing a 32% reduction since 2004, with most of these deaths occurring in sub-Saharan Africa (56).

As part of HIV and TB management and control plans, the WHO recommends a combination of antiretroviral treatment (ART) and the three I's to lessen the morbidity and mortality resulting from TB between people living with HIV (57). The three I strategies are (i) Intensified case-finding of TB (ICF), which is the critical component among the interventions, (ii) Infection control (IC), and (iii) Isoniazid preventive therapy for TB diagnosed negatives (57). However, the primary implementation bottlenecks of TB/HIV activities in sub-Saharan Africa in which studies were conducted have been more of limited resources and technologies to identify and eliminate active TB, high treatment dropout rates and side effects mainly due to hepatotoxicity and the risk for INH-resistant TB after IPT administration (58,59). Another major implementation bottleneck in SSA is the suboptimal level of incorporating TB and HIV Care (58), even though the implementation of the joint TB/HIV collaborative activities saved about 8.4 million people globally (56). However, it is characterised by low HIV counselling and testing uptake in TB clinics, a high workload, and a significant amount of cross-referrals between both services, usually not within the same health facility (60). Some of these bottlenecks have resulted in low TB treatment success rates after registering smear-positive TB cases under the DOTs strategy within the sub-Saharan African region (61). In a systematic review of the treatment success rate for pulmonary TB patients who were adults located within sub-Saharan Africa between 2008 and 2018, the pooled treatment success rate was 76% (61). This falls below the global rate of 83% and the WHO target of 90% (61). The pooled cured rate was 64.5%, and the pooled treatment completion rate was only 13.7% (61). There are also wide variations with the country-specific TB treatment success rates in SSA. Studies have shown a TSR of 80% in South Africa (62), 90.1% TSR in Ethiopia (63), 39% TSR in Uganda (64), 70% TSR in Zimbabwe (65), 57.7% TSR in Nigeria (66) and 85% TSR in Ghana (67).

Irrespective of the enormous challenges that TB and HIV diseases posed to healthcare systems and the WHO recommended policy interventions in sub-Saharan Africa, only 9% of PLHIV had been screened for TB. Moreover, only 3% were put on IPT (19). To identify and address the gaps to improve the implementation process, country-specific information assessed the extent or degree to which the potential implementers of the various interventions, such as the

active TB case finding among PLHIV is implemented and the factors that influence the implementation are required in urgency.

2.4 Tuberculosis in Ghana

2.4.1 The burden of TB and TB/HIV co-infection in Ghana

Tuberculosis is highly endemic across all regions in Ghana. The country is one of the documented countries with the most burdened TB/HIV in the world. Ghana recorded 44,000 TB cases and 15,800 TB deaths in 2018 (67). The incidence rate was estimated to be 148 per 100,000 population, with men being the most affected; male to female infection ratio of about 2:1, and males over 45 years recording the highest-burden (67). The TB case notification rates vary across the different regions, with the lowest being 23.7 cases per 100 000 population in the Northern region (now Northern, Savannah and North-East regions), with the highest being 77 cases per 100 000 population in the Volta region (now Volta and Oti regions) (67,72). The estimated number of people who developed TB and were co-infected with HIV (HIV-positive TB incidence) in 2018 was 8600 cases and 29 cases/100 000 population was the incidence rate. Also, 870 cases were multi-drug resistant tuberculosis (MDR/RR-TB0 in 2018, having an incidence rate of 2.9/100 000 population (67). The total TB case fatality ratio as of 2018 was 39%, with about 64% of all TB-patient households experiencing an impact of major and sudden healthcare expenditures (67).

In Uthman et al.'s (2009) study aimed at determining the spatial distribution of TB/HIV deaths in Africa, they found that Ghana was in the medium-endemic category (between 11.5-30.5 deaths per 100 000 population) per year (46). The Centre for Diseases Control and Prevention Division of the Global HIV and TB reported that in 2017, the TB incidence was estimated as 152/100 000 population with a mortality of 36 per 100 000 population (73).

Interventions to accelerate the decline in the burden and incidence of TB and TB among PLHIV and mortality are essential. But what is more important is the availability of reliable information on the barriers and enablers of the implementation and the degree of implementation of the intervention.

2.4.2 Tuberculosis and HIV collaborative activities in Ghana

In July 1954, Ghana established the Ghana Society for the Prevention as the first TB control programme to support and supplement the government's efforts to combat TB (74). The WHO DOTS Strategy was later adopted by Ghana in 1994, which was grounded on the commitment of politicians; sputum smear microscopy diagnosis, standardization of supervised treatment, regular drug supply and recording and reporting system (74,75). The Ghana National TB Control Programme (NTP) currently implements the DOTS Strategy as the primary intervention for TB control (74,75).

In response to the global dual epidemic of TB/HIV, Ghana recognised high tuberculosis and HIV dual infection in the country and that each of these diseases fans the impact of one other. After the policy guideline of WHO on TB/HIV joint activities in 2004, a mechanism for commissioning the TB/HIV collaborative activities was introduced in Ghana as early as 2005 at the national level through the establishment of a national TB/HIV coordinating council (76). The established body demarcated roles and responsibilities for both the TB and HIV control programmes, intending to reduce or minimise duplications of efforts in the fight against both diseases and to coordinate scarce budgets. As a result, the two programmes enhanced their services to ensure that something is done to reduce HIV morbidity and mortality in the country by the NACP. In contrast, the NTP ensured that something is also done to reduce the morbidity and mortality of TB in Ghana.

The coordinated efforts of NTP and NACP led to the implementation of a national policy in line with the WHO TB/HIV collaborative policy guidelines in 2007 to fight and halt the emerging epidemic (15,24). Three-fold policy goals were set; "to strengthen the health system to respond to the TB/HIV dual epidemic, decrease the burden of TB in people living with HIV/AIDS, and decrease the burden of HIV in TB patients" (15,76). Three TB/HIV integrated service models were also ongoing at various healthcare delivery facilities (76). Firstly, screening of TB clients for HIV at TB clinics and linked to care; secondly, screening of PLHIV for TB at HIV clinics at every visit and treated and thirdly, some levels provide one-stop service delivery for TB/HIV, and the others make referrals between programmes (76). The policy made sure referrals systems were in place to remove bottlenecks for the patients and provider, screening tools and algorithms to facilitate this collaboration, and programme guidelines and manuals for training reflect TB/HIV co-infection management (76).

To control the burden of TB, one of the guideline approaches was the active or intensified case finding which means "the systematic identification of people with presumptive active TB, in a predetermined target group, using tests, examinations or other procedures applied rapidly" (77). What was crucial to this active case finding is the systematic pro-activeness by trained health workers to conduct screening among the predetermined high-risk population compared to screening in response to individual complainants seeking healthcare. These predetermined high-risk populations included immigrants from areas with high rates of TB, groups with increased rates of TB infection, including PLHIV, the homeless and those on drugs, etc. On the other hand, TB case finding responded to individuals' complaints during care-seeking was termed a passive case finding (77). The passive case finding was the old approach of TB case finding, which led to missed TB cases in an earlier and usually less infectious stage at the facility level (7,78). Compared with the passive, health care providers actively screened for TB without clients complaining of symptoms by themselves.

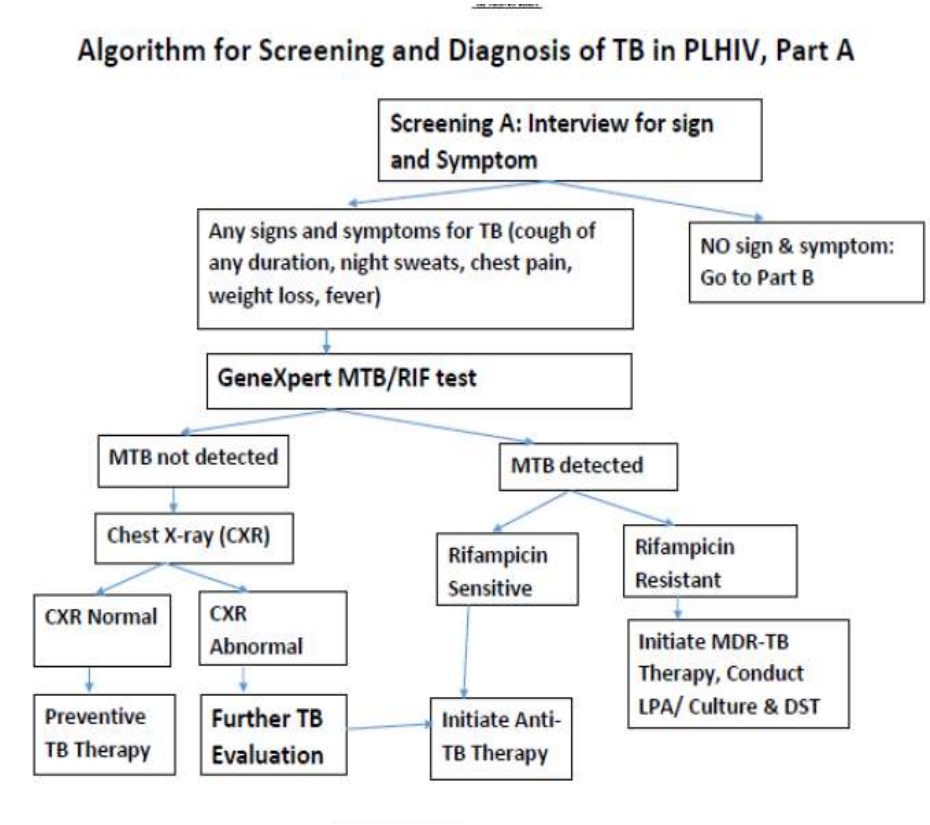
The fact that HIV weakens the immune systems make PLHIV prone to TB. It is important in the TB/HIV double epidemic fight to reduce the TB fanning effect within HIV clients. A person with latent TB infection can develop TB if the person becomes HIV positive. WHO therefore recognised the screening of PLHIV for TB components of its recommended policy as key in the fight for TB control. Thus, this fundamental approach required all PLHIV to have routine TB at every clinical encounter (3,15). In addition, they are supposed to be given education and counselling on TB at the clinic. Through screening for TB, the client aided with a simple questionnaire seeking whether clients experience symptoms such as fever, loss of weight, cough irrespective of the duration, and night sweats in the past defined period. This was followed by a confirmatory diagnostic test with either X-ray or GeneXpert or rapid diagnostic for all suspects (positive response to one or more of the symptoms), initiating appropriate treatments and ensuring TB infection control at all HIV care clinics in Ghana (16,79).

Before 2018, all the HIV clients screened negative for TB were not put on IPT because it was not a national policy (15,24). At the HIV care clinic from 2007 to 2017, IPT use was only supported in specialised cases where treatment of a patient is supervised through to finish (23,24). In 2018, the Ghana Health Service, through the NTP and NACP, planned to begin the implementation of the IPT use in phases at HIV clinics for all HIV clients who have screened negatives for TB, starting in some selected HIV care clinics with the hope of spreading to all HIV care clinics by the end of the year 2020 (79). 27 facilities from the ten Ghana regions with digital X-ray facilities and GeneXpert for conforming TB test results were identified to begin

the IPT initiation. In 2019, facilities with any digital X-ray machine or GeneXpert will implement the IPT, and in 2020 all HIV care clinics with or without any of the devices will initiate the IPT (23). At the **facility** level, each facility implementing the intervention has to ensure amongst others the availability of providers trained on TB/HIV, availability of IPT, lab and testing equipment, protocol and guidelines for the providers, tools and ensuring meetings (15,24).

Every HIV care provider is expected to go through the clinical protocol for every HIV client seen. The main activities on the clinical protocol include TB education, counselling, screening for TB using the screening algorithm, requesting for confirmatory test and initiation of IPT or appropriate treatment (1,7,15). Nonetheless, TB screening coverage among PLHIV were low and fluctuated overtime since the implementation of the TB screening intervention at HIV and ART clinics. Such an abysmal performance is most likely to be attributed to the extent to which the intervention is implemented, unavailability of resouses and logistics and, possibly inadequate training for the healthcare workers. The two programmes revised the screening algorithm in 2017 to include IPT initiation before implementing the IPT administration, as shown by Figure 3. Every HIV client is screened at the ART/HIV clinic for clinical signs and symptoms of TB. Confirmatory tests are further conducted before appropriate treatment is given. The guideline suggests that IPT can only be given if the PLHIV has a normal chest X-ray. But in 2018, and as a high TB/HIV burden country (80), about half (50%) of the PLHIV were screened for TB with none being put on IPT (45). The reason behind the failure or low uptake of IPT in the country could be similar to what was found Uganda setting due to context similarities. Pre-IPT counselling and logistical supplies at the HIV clinics coupled with training of healthcare providers, supervision, and monitoring of the implementation (81).

The national TB survey conducted in 2013 in Ghana indicated that TB prevalence in Ghana was 290 per every 100,000 persons compared to WHO estimates (72/100,000 persons) in the same year (9,79). Available reports from the national HIV Sentinel Survey show that HIV prevalence declined from 3.6% in 2003 to 1.6% in 2014 (82). There was, however, a slight increase to 1.8% in 2015 and 2.4% in 2016 (82). The current TB/HIV dual epidemic in Ghana is of public health concern due to its population health and social impact (83). Sector reports from the TB and AIDS control programmes show that the working and active population between 30 to 39 years are mostly affected (9,82). Studies conducted in Ghana have shown that TB caused 40-50% of deaths in HIV positive people (83,84).



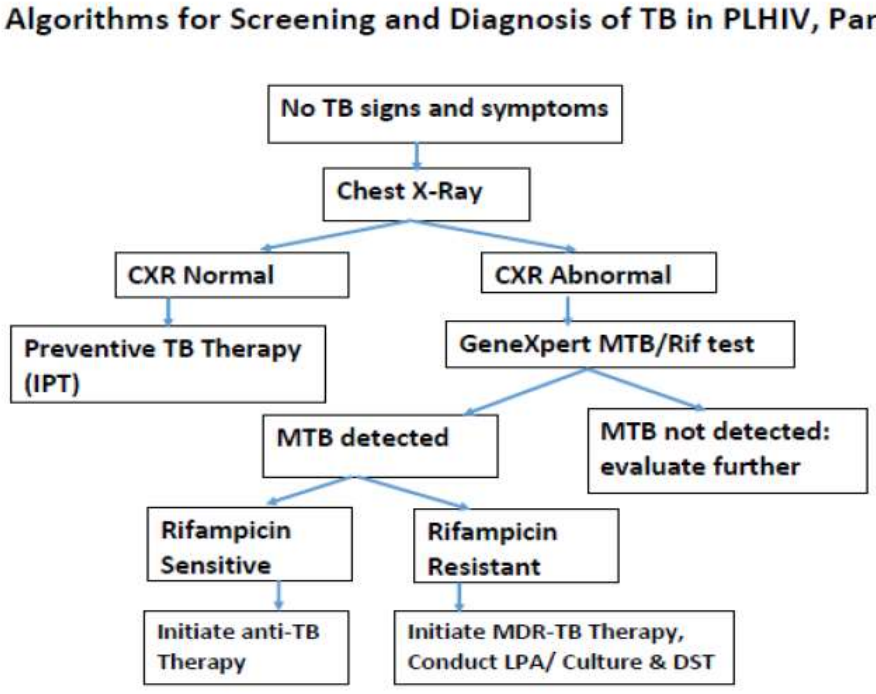


Figure 3: Revised screening algorithm (source: NACP)

In 2017, according to the global tuberculosis report 2018, the number of new people enrolled in HIV/ART care clinics was 31,058, of which 1,456 was notified as a TB case (80).

The ambitious targets set by the TB/HIV programme could be achieved based on the intervention being implemented as planned by the NTP. But efforts to achieve the desired outcomes are seemingly not informed by an understanding of the constraints that may hamper successful implementation (e.g. fidelity to the intervention by the facility and the health care provider) (20–22,26,85)

2.4.3 Funding the needs of TB control

Progress in TB control all over the world requires adequate funding that is sustainable for longer years. The primary funding for each country towards TB care and control is by domestic resources for its health services budget, and by donors, and bi-national and multinational donor partnerships. For instance, the BRICS (Brazil, Russia, India, China, and South Africa) and upper middle income countries, which account for almost half the world's TB cases funds almost all their funding needs from domestic sources to support the TB control. Nonetheless, the main source of funding for TB control for low to middle income countries relies heavily on international donor funding, mainly the Global Fund. TB control funding grew considerably since 2002, showing impressive cost-benefit gains across the globe (68). Conventionally, an intervention is considered cost-effective if the cost per year of life saved is less than the gross domestic product (GDP) of a country (69), which is the case in many countries (70).,

The average cost incurred by TB patient in low- and middle-income contours is catastrophic. Such catastrophic cost out-of-pocket leads to impoverishment of household and prevents access to healthcare. Hence, the TB management and treatment care has been free under the Ghana National Tuberculosis Programme. In Ghana, the current strategy for controlling the TB relies much on implementing and scaling up best known practices, while addressing the problems of most affected populations such as PLHIV. The principle underlying implementation is strong coalition with civil society organizations and communities (Stop TB Partnership, Ghana) and working in partnership with other state agencies such as Attorney General's Department, to ensure protection and promotion of patients' rights, ethics and equity under National Health Insurance Scheme (NHIS), Food and Drugs Authority (FDA) and Public Health Act. There is available TB screening tools/questionnaire and diagnostic tools which had led to the shift from passive TB case finding to active case finding. Ghana piloted the award winning evidence

based WHO guideline, Systematic Screening for active tuberculosis (principles and recommendations). During the piloting, the cost of the strategic plan was assessed through WHO planning and budgeting tool. According to the national TB health sector strategic plan for Ghana from 2015 – 2020 (71), it was estimated that an amount of USD 358,817,198 to implement the six year National Health Sector Strategic Plan. The Government of Ghana provided 30% of the annual budget needs while the Global Fund-financing mechanism provided 6% of the total funding needs for the first three years. Hence, the successful implementation of the plan depended on a continuous stable political climate in the country and increased, predictable and sustained funding from other developmental partners.

2.5 Implementation fidelity assessment of health interventions

Fidelity of an intervention is one of the eight implementation outcomes that can be examined to assess an intervention's applicability, progress, or performance in a real-life setting. Several terms and phrases have been used to describe implementation fidelity assessment in healthcare interventions. Terms such as fidelity, integrity, adherence (although this is a component of fidelity), treatment fidelity, intervention fidelity have all been used to describe fidelity of implementing healthcare programmes or interventions (21,27,86–93). All these terms share a similar definition of implementation fidelity as the extent to which program developers deliver a healthcare intervention to recipients as intended or planned (27,87,88,90,91). In addition, implementation fidelity is usually defined in specific dimensions of a healthcare intervention that need to be measured or assessed (21,27,86,88,89,91–97). These dimensions are adherence to the content of the intervention, dose, delivery quality, responsiveness of the participant, and differentiation of the program (27,86,91,95).

Adherence means how the healthcare providers follow the intervention protocol (27,86). Adherence is the main measure of implementation fidelity (27), and it focuses on the number of prescribed activities as predefined in an intervention guideline or by the intervention protocol (91). The intervention’s content is the active ingredients; the diagnosis procedure, screening, drug, treatment, skills, or knowledge that the intervention seeks to deliver to its participants (27,86). Dosage or exposure means the quantity of the intervention that the participants received; in other words, whether the frequency and duration of the intervention are as comprehensive as agreed by its designers (27,86). Quality of delivery on the other hand

is how a staff member or provider carries the program (27,86). Participant responsiveness is concerned with the responsiveness and or engagement of participants to an intervention (27,86). The fifth is program differentiation which is "identifying unique features of different components or programs" and identifying "which elements of programmes are essential", deprived of which the programme will not have its intended effect (27,86).

There have been recent advancements in the methods used to gather and analyse fidelity data. These methods include provider self-reports, observations, project documentation, client records, and participant surveys. The self-report approach comprises data collected directly from the provider or intervention recipient using checklists or verbal reports (98). Questionnaires and interviews are examples of self-reports. With the questionnaire method, the participants record their answers.

On the other hand, with the interview method, the interviewer records the responses given by the participants (98–100). In self-report fidelity assessment, implementers are mostly asked to specify whether they offered the identified constituents of the intervention guideline and ask the intervention recipients if they received the specified intervention activities. Instead of inferring by observation, participants describe their own experiences. Hence self-report approaches are not costly and do not waste time compared to observational techniques, but self-report data faced are potentially affected by validity and accuracy issues (99). For example, participants may report biasedly about the implementers based on their feelings towards the implementer (91), and provider ratings of fidelity can be skewed positively due to social desirability bias. Such bias can also be limited by providers' or participants' ability to recall accurately or provide correct information (86). Despite this, self-report interviews allow study participants to define and or come out with their understanding and practice. Behavioural observations of an implementation process turn to produce a more objective assessment of the program. It allows observers to examine whether implementers delivered the recommended content, used the correct delivery technique, engaged the recipients during the delivery, or expressed interest in providing the intervention (86,91). Observational procedures may consist of checklists, scaled rating forms, or qualitative descriptions of project implementation (86). However, observational methods are expensive, require more observers, and implementer reactivity to observation can change implementation fidelity (91). For example, although some implementers may be more adherent to the intervention guidelines, they might be anxious while under observation, which can influence the level of adherence or competence (91). Therefore, the effect of reactivity may underestimate the status of implementation fidelity (91).

Facility and administrative records, such as registers, case count, and client records, are crucial in assessing implementation fidelity (86). For example, TB screening coverage among HIV positive clients can be assessed using HIV clinical care registers. In addition, a review of clinical records can determine if certain intervention elements were delivered by providers (86).

Irrespective of the method used, developed fidelity tools can take on either dichotomous, Likert scale, open-ended responses, or any combination subject to the kind of intervention, nature of the data, and type of analysis (27,86). In assessing fidelity, the fidelity data should be compared to what the implementation guideline specified as core to be delivered to assess the level at which each component of the intervention is provided (86). Another fidelity assessment approach that has shown more statistical power in its process involves continuously analysing implementation fidelity data using the full range of implementation data (20). In this case, percentages can be used to assess the level of fidelity achieved and correlated with outcomes (20). Combined scores can also be created with program data to reflect the overall level of fidelity based on the sum of all fidelity items or dimensions (101).

Mowbray et al. reviewed literature extensively on the steps to develop, measure, and validate fidelity criteria (101). As shown with examples from literature in Table 1, three key steps in creating fidelity criteria are identified as (1) identification of critical components of the intervention, its data sources and operational definitions, (2) collection of data to measure the indicators through an appropriate method, and (3) assessing the indicators regarding their validity and reliability (101).

Whenever the health workers perform TB screening activities, some level of quality is compromised. This quality could also be in terms of numbers screened against what was to be screened or in terms of activities performed as screening in totality. The extent of adherence to the WHO policy guideline on screening determines the level of fidelity of the intervention. According to the WHO 2015 Global Tuberculosis Report, the total reported number of PLHIV screened for TB in 2014 was just seven million (102). Also, a study in Kenya has shown that 1.6% of PLHIV were not screened for TB, and about half (51.5%) were screened for TB at each ART or HIV clinic visit (103). The policy required every PLHIV to be screened at every visit to the clinic (77).

Table 1: Fidelity Criteria: Process of development, measurement and validation

Article	Area of focus	How Criteria were Developed	How Criteria were Measured	How Criteria were Validated
Becker et al. (2001) (104)	Supported employment (SE) programs model for adults with s severe mental illness – Individual Placement & Support (IPS)	From the IPS manual, authors' experience in implementing a model and SE literature	Semi-structured interview conducted with knowledgeable staff from the program	SE programs in 10 mental health centres rated on fidelity; 2 out of 3 components correlated significantly with competitive employment outcomes
Hernandez et al. (2001) (105)	Systems-of-care practice review using families with severely emotionally disorder (SED)	The 4 domains of the system-of-care practice review protocol were used	Review of document and interviews conducted with families by a team of 6 professionals trained in the use of instruments	System of Care Practice Review (SOCPR), 34 questions, 7-point ratings. Interrater reliability test of the SOCPR
Kelly et al. (2000) (106)	HIV prevention/ intervention programs funded by CDC	Core elements of intervention determined from participant feedback, experienced facilitators, and community advisors	Not mentioned	Core elements should consistently relate to outcomes across sites and key characteristics may relate to outcomes at some sites
Clark et al. (2016) (97)	Community-based opioid overdose prevention program educational intervention	Fidelity checklist modified and used in 2 phases.	Researchers complete modified fidelity checklist on components of adherence and competence.	The fidelity checklist is an already validated and reliable tool
Article	**Area of focus**	**How Criteria were Developed**	**How Criteria were Measured**	**How Criteria were Validated**
Breitenstein et al. (2010) (96)	Community-based parenting intervention in child care centres saving	Group leader assessment with fidelity checklist	Semi-structured questionnaire with parent groups, parents and group leaders; group lead self-reporting	Interrater & internal consist. Reliability and validity;

	low-income families – Chicago Parent Program			
Abry et al. (2015) (107)	Core components and active components of an intervention – Social-emotional learning intervention.	Observation of teachers on core components and students' academic performance through standard test.	Observed teachers and teachers self-reported	Multi-method confirmatory factor analysis; consistency and validity (Cronbach's alpha)
Henna Hasson(2010) (90)	Complex interventions in health care; RCT of Supported Employment among people with severe mental illness	A conceptual model for evaluation using a modified Conceptual Framework for Implementation Fidelity	Multi-method approach – KII, observation, questionnaire, document review.	Not mentioned
Hasson et al. (2012) (108)	Care program for frail elderly people in health and social care	Core component of intervention identified through a modified Conceptual framework for implementation research	observations of work practices, stakeholder interviews, and document review	Not mentioned
Kok et al. (2017) (109)	Voluntary sector-led community health programmes	Audio recording of programme group sessions	Recording and feedback questionnaire	Inter-rater agreement; kappa statistics (k)

2.6 Fidelity levels of an intervention

According to Mihalic et al. 2002 and Carroll et al. 2007 (27,110), implementation fidelity is defined as the extent of implementing the intervention as intended, which is pertinent to the success of translating an evidence-based intervention to a real-life setting. An implementation that attained the highest level of fidelity means less or no changes were performed on the original design or intervention (95). Different studies have measured and described the degree or extent differently; in percentages, in two levels (high and low), in three levels (low, medium and high), etc. These levels are guided by what other researchers have done because there are no known norms or agreement for an acceptable level of implementation fidelity in the literature (111).

Lebina et al. used a categorization similar to how facilities under the Department of Health Ideal Clinic Realization and Maintenance Programme in South Africa scored and rated their clinics (92). They ranked the facility silver for scoring 70-79%, gold for scoring 80-89% and platinum for scoring 90-100% (92). Also, for other studies that used percentages to describe fidelity level, Breitenstein et al. and Kok et al. set 80% as the minimum acceptable level of fidelity (109,111). Meaning scoring less than 80% is an unacceptably low fidelity level for implementation. Other studies also considered that the higher the percentage score, the higher the implementation fidelity.

The fidelity level is influenced by certain factors identified in the literature to act as barriers or facilitators of implementation fidelity. These have been termed moderating factors by the framework proposed by Carroll et al. (27)

2.7 Moderating factors of implementation fidelity

The level or extent of fidelity with which an intervention is delivered may be influenced, moderated, improved, or reduced by several factors (27). These are known as moderating factors and can affect the relationship as barriers, facilitators, hinders, promoters between an intervention and its intended outcomes (86,91). Potential moderators of implementation fidelity cited in the literature are made up of intervention complexity, strategies for facilitation, delivery quality, participant characteristics and responsiveness, program differentiation etc. (27,86,91).

Intervention complexities refer to whether the intervention is easy or difficult to implement, and well outlined or vague (27). Comprehensive or precise programs are most likely to be delivered with a fidelity level that is high than imprecise or unclear ones (27,112). Thus, the completeness and the nature of the description of the intervention can impact the extent to which the prescribed details of the intervention are successfully adhered to during implementation (27).

Facilitation approaches or strategies include all the support mechanisms that can help optimise or standardise the delivery of the intervention (113). Such methods include providing manuals, guidelines, training alongside in-service training, coaching, monitoring, and feedback to the implementers of the intervention (27). For example, a study conducted to assess fidelity of implementation of an exercise programme for adult females who had hip fractures made use of direct observation as a facilitation strategy to monitor the intervention during implementation. It provided the corresponding feedback to the intervention providers (114). This helped providers prevent and control deviations from the intended programme activities (114).

Quality of delivery deals with how or whether an intervention is implemented appropriately to realise intended objectives or not (27,86). Aspects of quality of delivery can consist of provider preparedness, provider competence, communication and interaction with intervention recipients (86).

Participant responsiveness refers to how intervention recipients respond to or participate in an intervention program (86). Participant responsiveness consists of the participants' interest level, perceptions about the importance and effectiveness of a program, and the participation level, eagerness, and readiness to involve in discussion or activities related to the intervention (86). For example, suppose participants view an intervention as irrelevant to them. In that case, their non-participatory may be a significant reason for unsuccessful or small coverage, and thus fidelity of delivery may be classified as low (27). Participant responsiveness is consequently influenced by participant characteristics which are also a moderator of implementation fidelity (91).

These moderating factors do not work in isolation but work together to improve implementation fidelity (27). There are usually relationships among two or more moderators. For example, if the amount of training provided for the providers of an intervention is minimal,

it will result in poor quality of delivery (27). A complex intervention can also affect the delivery quality and participant responsiveness of the intervention (27).

Some barriers to the fidelity of implementation of an intervention in real-life settings have been documented. Among such barriers are the adaptation of the intervention locally, variations in the individual level of competence and adherence of the providers, minimum or lack of training, resources, and technical support, to promote the program at the implementation level, and competing demands for the time of the providers can diminish their commitment or effectiveness (34,37).

2.8 Implementation determinants of health interventions

Unlike the moderating factors identified to influence the implementation fidelity to an intervention, the implementation of the whole programme or intervention could also be affected by many other factors. In implementation science, such factors are termed implementation determinants. A scoping review by Nilsen et al. (2019) revealed that determinants meant elements with influence on implementation (117). Many terms such as barriers, demotes, hinders, obstacles, impediments, enablers, promoters, and facilitators were found to be used for determinants, with others defined in contextual forms as external barriers", "environmental factors", "environment", "external environment", "inner setting" and "outer setting", "system characteristics" and "organizational drivers" (117).

Regardless of which term is used in implementation science, the significance of the context is based on frameworks. Many determinant frameworks have been formulated and used to address barriers and facilitators of implementation: Grol and Wensing (118); Fleuren et al. (119); Feldstein and Glasgow (120) (Practical, Robust Implementation and Sustainability Model – PRISM); Damschroder et al. (121) (Consolidated Framework for Implementation Research – CFIR); Flottorp et al. (122) (Tailored Implementation for Chronic Diseases – TICD); Greenhalgh et al. (123); Fixsen et al. (124); Blase et al. (125) (Active Implementation Frameworks – AIF); Nutley et al. (126); Mäkelä and Thorsen (127); Wensing et al. (128); Rainbird et al. (129) (National Institute of Clinical Studies – NICS); Cochrane et al. (130); Gurses et al. (131); Cane et al. (132) (Theoretical Domains Framework - DTF); and Harvey and Kitson (133) (Promoting Action on Research Implementation in Health Services – PARIHS).

Without a theoretical framework, the generalizability and or building on results of other studies from conducting implementation research will be a challenge. Damschroder et al. (2009) (117) carried out a literature review of implementation science from many frameworks that exited. They integrated existing theories into a consolidated framework to guide implementation research called the Consolidated Framework for Implementation Research (CFIR) (121). The CFIR is one framework used widely in addressing influences on implementations due to its detailed and specific contextual determinants. The CFIR framework was developed to guide data collection, coding, analysis, and reporting (134). The method of study when applying CFIR could vary from mixed method, quantitative or qualitative (134) approach depending on resources available and aim. The CFIR is made of 5 domains and sub-categories referred to as constructs. According to the authors, these domains are; (1) *Process* which involves planning, engaging opinion leaders and champions, executing, reflecting and evaluating by providing feedback about progress, (2) *Inner setting* focuses on structural characteristics focusing on age and size of the facility), networks and communications, culture, implementation and readiness for implementation, (3) *Outer setting* looks at patient needs and resources, cosmopolitanism, external policies and incentives, (4) *Intervention characteristics* consisted of the features of the intervention that might influence the implementation, and (5) *Characteristics of the individual* involved factors of the individual that could influence the implementation (121,135).

2.9 Implementation determinants of TB screening among PLHIV

In this context, implementation determinants of TB screening intervention among PLHIV are factors (barriers or enablers) believed to influence the implementation processes and successes (117). The most current research concentrates on preventing individuals, especially PLHIV, from getting infected with TB. There are proven effective measures to ensure that PLHIVs do not get the disease. Appropriate treatments must be discharged earlier to avoid death resulting from delayed diagnosis or the proper treatment, even if they do. Effective TB control is ideal; however, some factors decisively affect the outcome of the intervention implemented.

Barriers and enablers of effective implementation of TB screening activities among PLHIV in a health facility may occur at many levels. These factors are constructs that include the outer setting, inner setting, intervention characteristics, and the individual's characteristics as outlined in the CFIR framework.

These constructs that could potentially influence the effective delivery of the TB screening activities among HIV positive clients are considered as below:

2.9.1 Outer setting

Variable or sub-constructs affecting the outer setting include the external policy and incentives, peer pressure, patients' needs and resources and the inter-facility network (121). For example, a systematic meta-analysis showed limited financial resources, collaboration and integration and health education were some of the barriers and facilitators for active case-finding policy implementation (136). Another study also identified longer distances, transportation costs, poor quality of services and stigma barriers to active TB case-finding (137).

2.9.2 Inner setting

Some inner setting factors have been found to affect the implementation of active TB case-finding and, therefore, its outcome positively or negatively (121). For example, networking and communication, available resources, leadership engagement, access to knowledge and information, culture (norms, values, and simple assumptions of a facility), implementation climate, structural characteristics (architecture, maturity, age and size of the facility), goals and feedback, relative priority, organizational incentives and rewards, and tension for change among others are the factors that constitute the inner setting construct known to influence the implementation of an intervention (121,134).

Dunbar found that lack of motivation, limited intervention supplies, understaffing, poor data quality, poor feedback systems and screening among the high-risk population were barriers to effective implementation (137). Also, Desalgen Dabaro found that the shortage of intervention supplies, staff shortage, and flawed health information system frequent interruption of water and electricity supply to the facility hindered active tuberculosis case-finding in Ethiopia (138). On the other hand, according to a new report by a staff News Editor at Insurance Daily News (Jan. 2020), enablers of implementation of active case-finding include the health system capacity, strategies for integration, education and collaboration (139). In the study conducted by Ahorlu and Bonsu to find the factors of low TB case finding in the north-western part of

Ghana, they identified lack of communication and networking between sub-district level facilities and district-level facilities in assisting with a confirmatory test as barriers (140).

2.9.3 Intervention characteristics

The intervention characteristics are one of the more modifiable factors that influence implementation. In resolving the healthcare problems, various strategies and mechanisms have been used by adapting evidence-based intervention and implementing it under different contexts in different countries. The various components of the intervention characteristics that can influence implementation include the source of the intervention (whether developed internally or externally), evidence strength and quality (seconding the fact that the intervention will work and attain expected outcomes), relative advantage, adaptability (depending on the context, whether the intervention can be adaptable), trialability (whether the intervention can be tested on a smaller scale before scaling up), the complexity of the intervention, design quality and packaging, and cost of intervention and cost of implementing the intervention (121,134,135)

2.9.4 Individual Characteristics

The knowledge and beliefs, self-efficacy, stage of change identification with the organization, and other individual traits positively or negatively influence implementation (121). The capabilities and skills of the individual cannot be underrated or overrated in the course of action to realise the implementation goal. The higher the individual feels about the possessed traits, the higher their self-efficacy and the ability to perform and achieve the implementation goal. According to Afoakwa and Taylor, the high Knowledge level of TB among health providers in Ghana will lead to increased TB case-finding (141). Other studies conducted in Ghana on low case detection of TB showed that 60-75% of health providers were not trained (141,142) by the National Tuberculosis Control Programme, which is their mandate.

2.10 Conceptual Framework of the study

The desired outcome of an intervention depends mainly on the quality of the implementation. For this study, fidelity is assessed at a provider and programme level. As a review, the literature states that the implementation quality of the intervention is influenced by factors (barriers and enablers) that determines the success or failure of effective intervention (6,20).

Figure 4 is the conceptual framework that was applied in this PhD study. It was developed based on two existing frameworks in the literature (27,121). This conceptual framework is constructed explicitly for this study by adapting the Conceptual Framework for Implementation Fidelity (CFIF) by Carroll et al. (2007) (27) and Consolidated Framework for Implementation Research (CFIR) by Damschroder et al. (2009) (121).

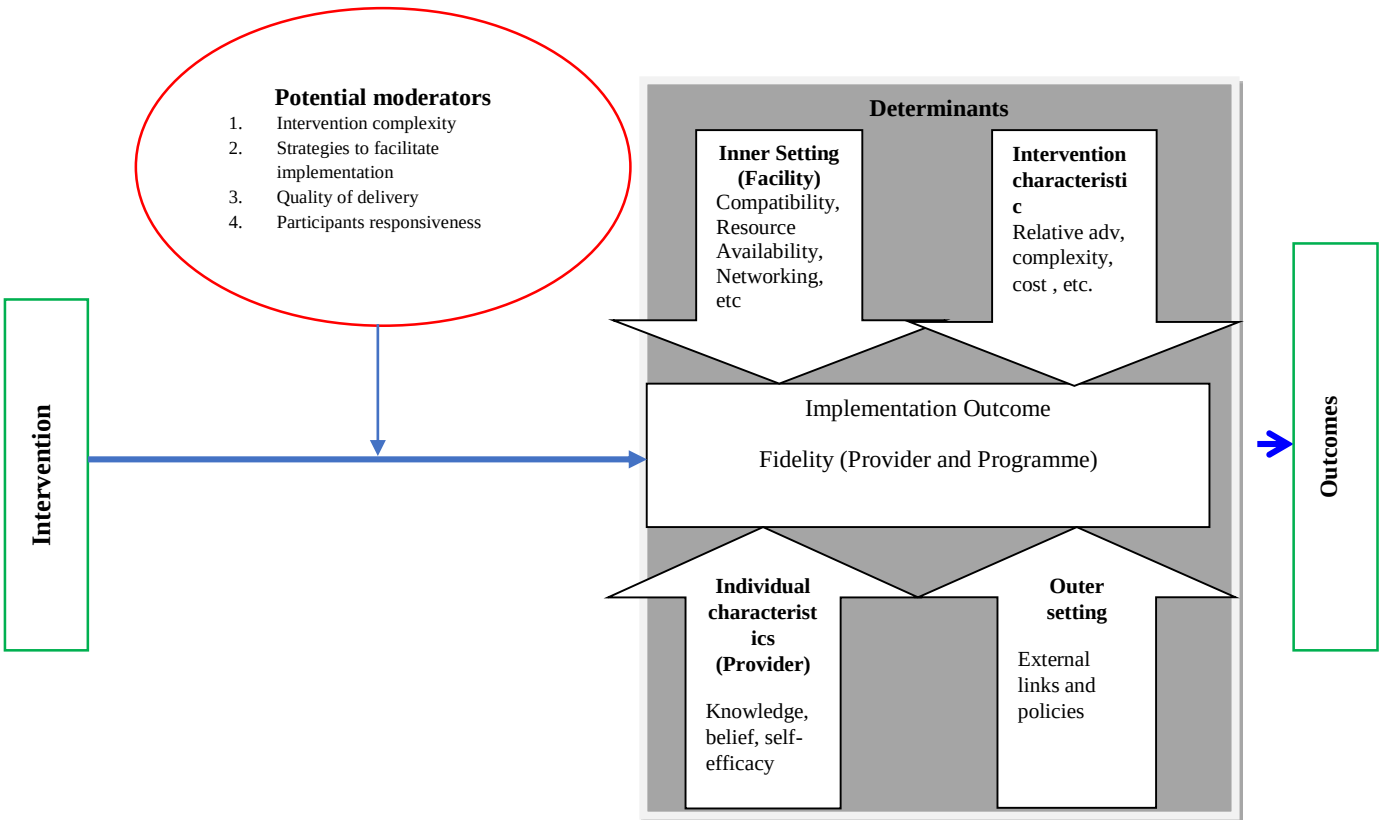


Figure 4: Conceptual framework for the study

According to the CFIF, whether an intervention achieves its intended outcomes is subjective by the level to which the intervention is offered as intended (fidelity) by the developers (in the case of this study, as planned by the NTP). But the relationship between the intervention and

fidelity is moderated by factors identified in the CFIF as potential moderators (27). Considering the potential moderators, if the providers and facility adhere entirely to the content, coverage, duration, and frequency recommended by NTP, then fidelity can be classified high. Figure 4 shows how various moderating factors come to play to influence the fidelity of delivering the intervention.

The variables that define fidelity in this PhD framework are adherence to TB/HIV intervention guidelines and potential moderators that influence implementation fidelity. As conceptualised by Carroll, adherence is the primary measure of fidelity comprised of content (whether the required intervention content was provided as intended by the developers) and whether coverage, frequency and duration of the implemented intervention were achieved as planned (27). In addition, the moderators influence the relationship between intervention and adherence. Some studies adopted this framework, while others successfully adapted this framework to assess fidelity (29,95,110,142). This study adopted this framework to evaluate fidelity at the provider, facility and combined provider-facility levels.

The CFIR is a determinant framework used to explore barriers and enablers of implementation (121). The study adapted the CFIR framework to explore determinants of implementation of the TB intervention. Four out of the five primary constructs were identified and selected in the framework to analyse the implementation determinants. The selection was constructed on the context in which the intervention was delivered. The fifth domain from the CFIR that was not explored is the "process" successfully measured through observation. In the context of this study, observational data collection is not feasible as it might raise privacy and ethical issues. We, therefore, chose domains in the CFIR that were important, feasible and measurable in the context of this study (143) to identify barriers and facilitators of the TB screening intervention amongst people living with HIV. Many studies have applied this framework in this manner (135,144). According to the CFIR framework, the quality of implementation is influenced by factors such as the characteristics of the individual providing the intervention (in this study, the providers in the clinic); the characteristics of the intervention, features of the inner setting (programme) which has to do with structural characteristics, internal networking and communication; and features of the outer setting which has to do with external networking and factors external to the facility (121). These factors were either enablers or barriers influencing implementation quality (which is fidelity at the provider and facility levels), as depicted by Figure 4.

3.0 Methodology

This section provides synthesised information discussing eight sub-sections, including where the study was conducted, methodological approaches, and ethical considerations about the study.

3.1 Study setting

The research was undertaken in 27 district hospitals with functioning HIV clinics in Ghana. These district hospitals are each located in administrative demarcated districts. Figure 5, shows a map of Ghana indicating the ten regions, ecological belts and the districts where the study was conducted.

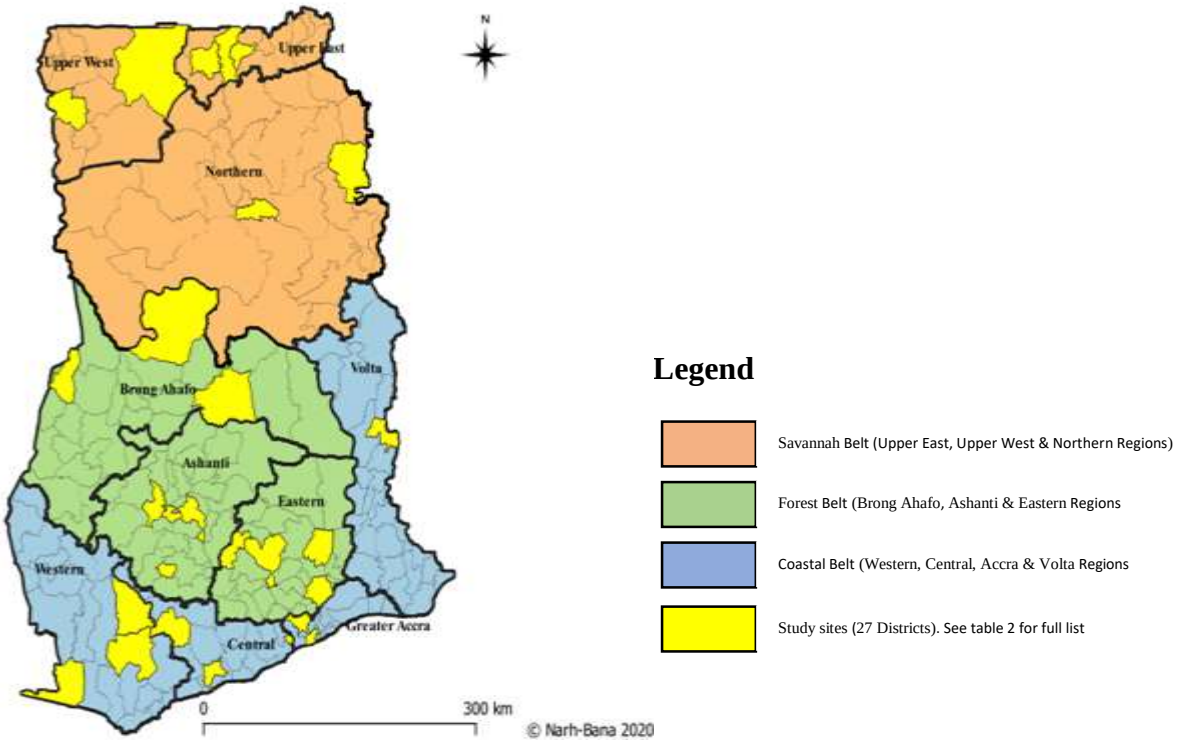


Figure 5: Map of Ghana showing study sites

The districts were under the then ten traditional administrative regions (Table 2). Different ethnic groups with varying local languages are spoken from one region to another. But *Twi*, a local language for the people in the Ashanti region, is widely spoken, at least by all. In 2019, the projected population for the 27 districts or the catchment population of these facilities

ranged from 68,578 to 2,105,382 (median population = 128,143). See Table 2. Most of the people in the districts lived mainly in scattered rural communities with about 3000 people. There is a gradation in widespread poverty depending on the type of district. The metropolitans are better off than the municipal, while the municipals are better off than the ordinary districts. The median land surface area covered by these 27 districts is 859 (range: 108 to 5054), as presented in Table 2.

Table 2: Basic factors of the district facility where the study was conducted

No.	Region	District Facility	Status	Population^	Area size Km^2	Rural¥ %
1	Ashanti	Atwima-Nwabiagya	Municipal District	180,296	579	68.5
2		Ejisu-Juaben	Municipal District	174,482	583	72.5
3*		Kumasi	Metropolitan District	2,105,382	214	0
4		Obuasi	Municipal District	203,554	221	14.8
5	Brong Ahafo	Atebubu-Amanten	Municipal District	131,400	2626	53.3
6		Jaman North	Ordinary District	102,829	1031	47.5
7		Kintampo North	Municipal District	117,118	4890	43.2
8	Central	Abura-Asebu-Kwamankese	Ordinary District	128,143	2626	53.3
9		Awutu Senya East	Municipal District	129,629	108	5.9
10		Twifo-Ati-Mokwa	Ordinary District	74,074	956	76.3
11	Eastern	Akwapim North	Municipal District	169,061	613	65.9
12		Atiwa	Ordinary District	136,550	1166	66.6
13		Birim North	Ordinary District	97,534	567	73.2
14		Upper Manya-Krobo	Ordinary District	87,789	859	87.3
15*	Greater Accra	Accra	Metropolitan District	2,087,668	140	0

16		Ga West	Municipal District	71,133	324	70.3
17	Northern	Saboba	Ordinary District	82,667	1751	90.6
18		Tamale	Metropolitan District	275,547	647	19.2
19	Upper East	Bolgatanga	Municipal District	160,308	397	50.2
20		Builsa North	Ordinary District	68,724	817	89.5
21		Kasena-Nankana	Ordinary District	86,519	873	86
22	Upper West	Nadowli-Kaleo	Ordinary District	74,498	1132	100
23		Sissala East	Municipal District	68,578	5094	81.2
24	Volta	Jasikan	District	72,970	556	72.4
25	Western	Jomoro	Municipal District	194,808	1495	64.6
26		Prestea-Huni Valley	Municipal District	207,237	1810	62.9
27		Wassa Amenfi East	Municipal District	108,272	1558	49.1
Median (min, max)				128,143 (68578, 2105382)	859 (108, 5054)	66 (0, 100)

^*Population projection from 2010 census.* ¥ *Composition of the district that is rural* (145).

All the ART/HIV clinics in Ghana have been conducting TB screening among PLHIV for over a decade. In 2018, the NTP planned the implementation of IPT administration as part of the policies to lessen the impact of TB amongst PLHIV in HIV care clinics in Ghana. The NTP programme selected the 27 clinics where the study was conducted to start the IPT intervention because the facilities had both geneXpert and X-ray machines to confirm TB diagnosis or test.

In each region, the TB/HIV coordinators or focal persons at the regional, district and facility levels work in harmony to ensure full implementation of the intervention. That is adherence to programme guidelines of the intervention. There is only one TB/HIV coordinator at the regional, district and facility levels respectively.

At the HIV care clinics, a trained healthcare provider is supposed to, guided by the clinical protocol of the intervention, administer the intervention, which is the screening of HIV clients for TB at the HIV clinics, request for confirmatory test for all suspected TB patients and putting the confirmed positives on appropriated medication. For those who tested negative, the plan for IPT initiation should have been followed. The HIV care clinic has either a physician or physician assistant as the head of the clinic, three-to-five nurses, one information officer, one pharmacist, one laboratory technician, and three-to-five other auxiliary staff. The laboratory technician and the pharmacist work with the HIV clinic and other clinics within the facility and do not provide direct TB screening for PLHIV. Therefore, about 9-13 health providers offer care to PLHIV in each HIV care clinic in Ghana.

3.2 Study design

The study was cross-sectional (descriptive and exploratory) in design. The study involved both quantitative as well as qualitative elements. It was conducted in two main phases, as shown by Figure 6 and explained below.

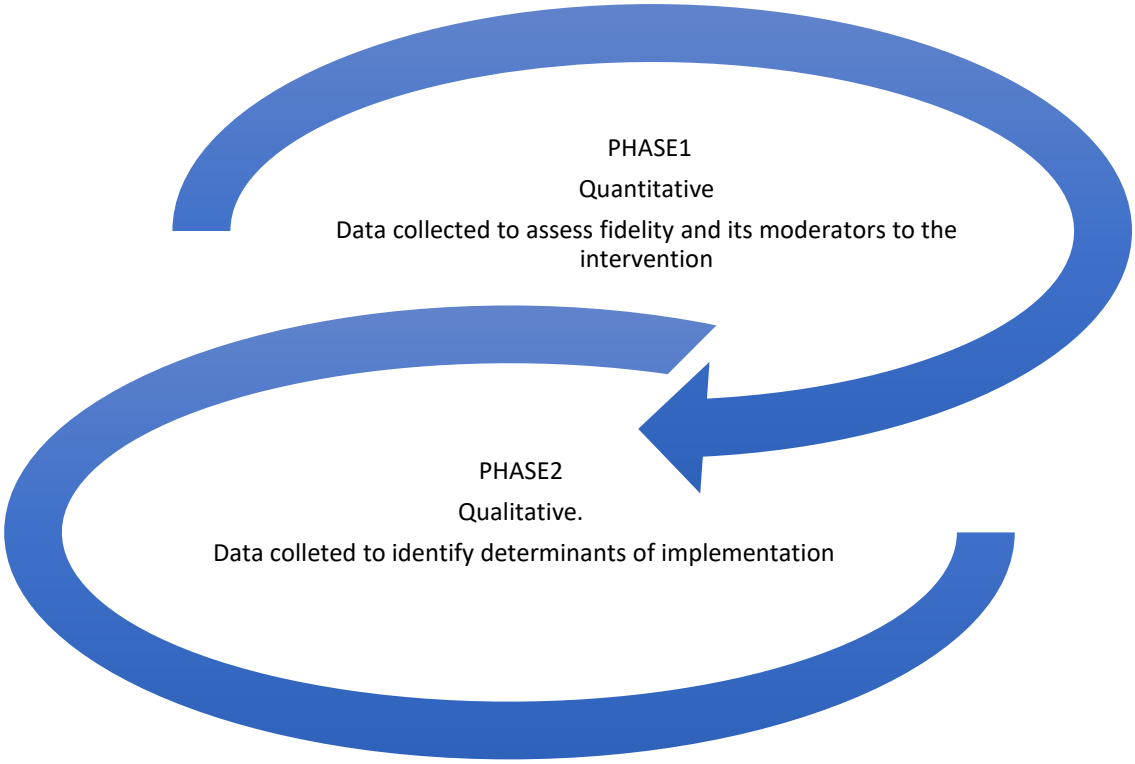


Figure 6: Phases of the study

Phase 1 (one) of the study was a purely quantitative study. It used a quantitative data collection technique to gather data to determine implementation fidelity to the intervention. It also used a census-based survey approach where all the 27 districts with hospitals that met the study's inclusion criteria across the whole country were visited for data collection. Information was collected to assess provider and facility level fidelity and potential moderators of fidelity to the intervention.

On the other side, phase 2 was purely an exploratory qualitative study. In the same vein, a qualitative approach was used to gather evidence to identify the factors that influence the implementation of the intervention. It explored facilitators and barriers to implementation from the health system's regional, district, and facility levels.

3.3 Study population

All district hospitals with HIV clinics or ART sites in Ghana were eligible to be included in the study. All the HIV care providers, heads of the HIV care clinics, and heads of the district hospitals were eligible to participate in the study. In addition, all the TB/HIV coordinators at the health facility, district health directorates and the regional health directorates were eligible participants in the study. Therefore the study population was all health workers involved in TB control and TB/HIV collaborative activities at the district hospital as well as district and regional health directorates.

HIV care providers were included in the study because, they deliver the intervention activities to the HIV clients. The head of facility was included because of the managerial role played by ensuring the provision of logistics and supplies for the implementation of the intervention. Finally, the facility district and regional TB/HIV coordinators were included in this study because they liaise between the programme designers and the implementers to ensure smooth implementation of the intervention at the facility.

It was expected that each HIV clinic would have between nine to thirteen care providers, one TB/HIV coordinator at the facility district and regional levels, and one head of HIV clinic and district hospital.

3.4 Inclusion and exclusion criteria

Inclusion criteria

- HIV clinics screening for TB and on the planned list to introduce IPT to those who tested negative for TB.
- Healthcare providers who have worked at the HIV clinics for at least a year.
- Facility, district and regional TB/HIV coordinators related to HIV clinics screening for TB and on the planned list to introduce IPT to those who tested negative for TB.
- Availability of HIV and TB registers at the HIV clinic for data extraction for the year 2018.
- Participants' consent obtained.

Exclusion criteria

- Healthcare providers in the participating district hospitals who do not provide direct care for HIV clients.
- District TB/HIV coordinators whose district hospitals were not included in the 27 hospitals
- Potential participants who were unavailable during the time of the data collection.
- Potential participants who refused consent to participate.

3.5 Sample size and sampling procedure

The number of participants per participating facility was established to determine the sample frame and include everyone eligible in the study. This effort was essential to maximize the good representation of participants in the study. Considering the number of districts, HIV care clinics, and the number of healthcare providers working in the respective clinics that constituted the participants of the study, selecting a finite part or a subset of participants for the study would have meant fewer participants than the required minimum, which could have affected or compromised statistical inference in terms of precision. In addition, a too-small sample would not be reliable and valid to conclude with some level of certainty. These reasons take precedence over several practical and theoretical reasons, including ethical issues, budgetary limitations, logistics, time restrictions, unknown target population, amongst others against census-based surveys (146).

Therefore, all the potential study participants were interviewed to maximize representation to assess fidelity (provider and **facility**) of implementing the active TB case finding in PLHIV attending HIV clinics and establish its influencing factors. Sample sizes were not provided before the study was conducted.

In phase 1, at the HIV care clinics, it was expected that each HIV clinic would have between nine to thirteen care providers. Therefore, the total number of health care providers expected to have participated in the study from the 27 clinics were estimated to be about 243 to 351.

However, 244 healthcare providers were established, falling within our anticipated range of 243 to 351 providers. Of these 244 HIV healthcare providers established, 226 were available, recruited and participated in the study. The number comprises between 6 to 12 healthcare providers per facility. Also, a total of 27 heads of the facilities or their representatives in terms of knowledge on TB/HIV activities within the facility were interviewed to elicit information at the facility level. Refer to Table 3, which summarises and presents the distribution and sources of interviews and discussions conducted for the study.

Table 3: Distribution of interviews and discussions conducted

Field Team No.	**Region**	**District Facility**	**Phase 1: Survey interviews conducted**		**Phase 2 IDIs and FGDs conducted**			
					IDI – TB/HIV coordinators			**FGDs**
			HIV clinic providers	**Head of the facility**	**Regional**	**District**	**Facility**	**HIV clinic providers**
1	ASHANTI **(AS)**	Atwima-Nwabiagya **(ASAN)**	8	1				
		Ejisu-Juaben **(ASEJ)**	9	1				
		Kumasi **(ASKU)**	8	1				
		Obuasi **(ASOB)**	7	1				
	BRONG AHAFO **(BA)**	Atebubu-Amanten **(BAAA)**	9	1				
		Jaman North **(BAJN)**	6	1				
		Kintampo North **(BAKN)**	6	1				
2	EASTERN **(EA)**	Akwapim North **(EAAN)**	11	1	1	1	1	0
		Atiwa **(EAAT)**	10	1		0	1	1
		Birim North **(EABN)**	9	1		1	1	1
		Upper Manya-Krobo **(EAUM)**	12	1		0	1	1
	GREATER ACCRA **(GA)**	Accra **(GAAC)**	11	1				
		Ga West **GAGW)**	9	1				
	VOLTA **(VO)**	Jasikan **(VOJA)**	8	1				

3	NORTHERN **(NO)**	Saboba **(NOSA)**	7	1	0	1	1	1
		Tamale **(NOTA)**	8	1		0	1	1
	UPPER EAST **(UP)**	Bolgatanga **(UPBO)**	6	1				
		Builsa North **(UPBN)**	7	1				
		Kasena-Nankana **(UPKN)**	7	1				
	UPPER WEST **(UW)**	Nadowli-Kaleo **(UWNK)**	7	1				
		Sissala East **(UWSE)**	6	1				
4	WESTERN **(WE)**	Jomoro **(WEJO)**	7	1				
		Prestea-Huni Valley **(WEPH)**	9	1				
		Wassa Amenfi East **(WEWA)**	9	1				
	CENTRAL **(CE)**	Abura-Asebu-Kwamankese **(CEAA)**	9	1	1	1	1	1
		Awutu Senya East **(CESE)**	10	1		1	1	1
		Twifo-Ati-Mokwa **(CETA)**	12	1		1	1	1
Totals			**226**	**27**	**2**	**6**	**9**	**8**

From the established list of providers at each HIV clinic or facility, participants were interviewed in turns in an isolated area devoid of onlookers and intruders to ensure privacy and confidentiality.

During phase 2, which aimed to identify factors that influence the implementation of the active TB case finding strategy amongst HIV positive clients at HIV clinics, one region was randomly selected from each of the three ecological zones of Ghana. Within the chosen randomly regions, 9 (range: 2 to 4) district hospitals with HIV clinics met the inclusion criteria. Therefore, the participating district hospitals with their respective district health directorates were involved in the study.

3.6 Data collection

Data on implementation fidelity and determinant were gathered with semi-structured questionnaires and interview guides through the use of face-to-face interviews. A data extraction form was also used to guide the data extraction through record review.

Before the data collection, field officers were recruited and trained. A total number of twelve (12) field officers who held a bachelor's degree in any discipline but with some level of experience in data collection were recruited. In addition, one research assistant knowledgeable

in TB/HIV activities and research was also recruited to assist with training. The field officers were put into four groups of three members. Two training sessions of 5 days each were conducted. The first session was organised in the southern part of the country for three groups, while the second session for the 4th group was organised in the northern part of the country due to logistical challenges.

The training involved an overview of TB control among PLHIV, an overview of the study, basic data collection techniques for conducting surveys, KIIs, IDIs, and FGDs, consent forms and consenting processes, the tools for both phase 1 and 2 studies, role-plays and pretesting. Field officers made critical changes, especially the wording of some of the questions with the carefulness of not changing the meaning of the questions. Role-plays were held, and comments were given after each session as part of the training, which led to a modification of the tool. On the last day of the training, the tools were pretested in two facilities similar to the study facilities, minimising measurement error and respondent burdens.

The field officers conducted an additional one-day refresher training before starting phase 2 data collection. The one-day refresher training was enough and helpful for the field officers to remember what was expected of them in the second phase of the data collection.

Table 4 summarises the expected and actual number of interviews conducted at the different phases of the study and the data source.

The field teams visited each of the assigned facilities for at least five working days. In addition, the team made follow-ups and return visits for respondents who were not available while still within the facility.

Table 4: Summary of the expected and actual number of interviews conducted

Study phase	Data type	Source of data	Number of facilities	Number of expected interviews	Number of conducted interviews (comments)
1	Quantitative	Healthcare providers at the HIV clinic	27	244	226

					(18 missed (12 on annual leave, 4 in a workshop, 2 transfer))
1	Quantitative	Facility heads/ TB/HIV focal person/ head of HIV clinic	27	27	27 (18 facility heads, 8 facility TB/HIV coordinators and 1 HIV clinc head)
1	Quantitative	HIV and TB clinical registers	27	27	27 records reviewed
2	Qualitative	**R**egional, **D**istrict and **F**acility TB/HIV coordinator	21	21 (R-3, D-9 and F-9)	17 (R=2, D=6, F=9) (D=3 on annual leave R=1 travelled)
2	Qualitative	HIV care providers	9	9	8 (1 group not up to minimum number for FGD)

*Note: R= **R**egional, D=**D**istrict and F=**F**acility TB/HIV coordinator*

Before the team got to the health facility, permission was first obtained from the regional and the district health administrations. Then, authorisation to perform the various studies at the health facility is again obtained. Furthermore, authorisation and or consent were sought from participants to audio record discussions and interviews where necessary. All the tools for this study were developed in English, and all the interviews and discussions were conducted in English.

Further information on data collection (this section) is presented under subsections 3.6.1 and 3.6.2 according to the data collection phase of the study.

3.6.1 Data collection for phase 1 study

Figure 7 illustrates participants' recruitments and study profiles for the phase 1 data collection. A semi-structured questionnaire was designed and used to conduct face-to-face interviews with

226 HIV healthcare providers at all the ART or HIV clinics involved in the study. Also, a key informant semi-structured questionnaire was created and used to gather data from 27 heads of the health of facilities. In the absence of the facility head, an appointed representative knowledgeable in the TB screening activities for HIV positive clients at the HIV/ART clinic was interviewed. In the end, 18 heads, eight TB/HIV coordinators at the facility level and 1 HIV clinic head were interviewed to get the 27 participants needed to assess the **facility** fidelity level.

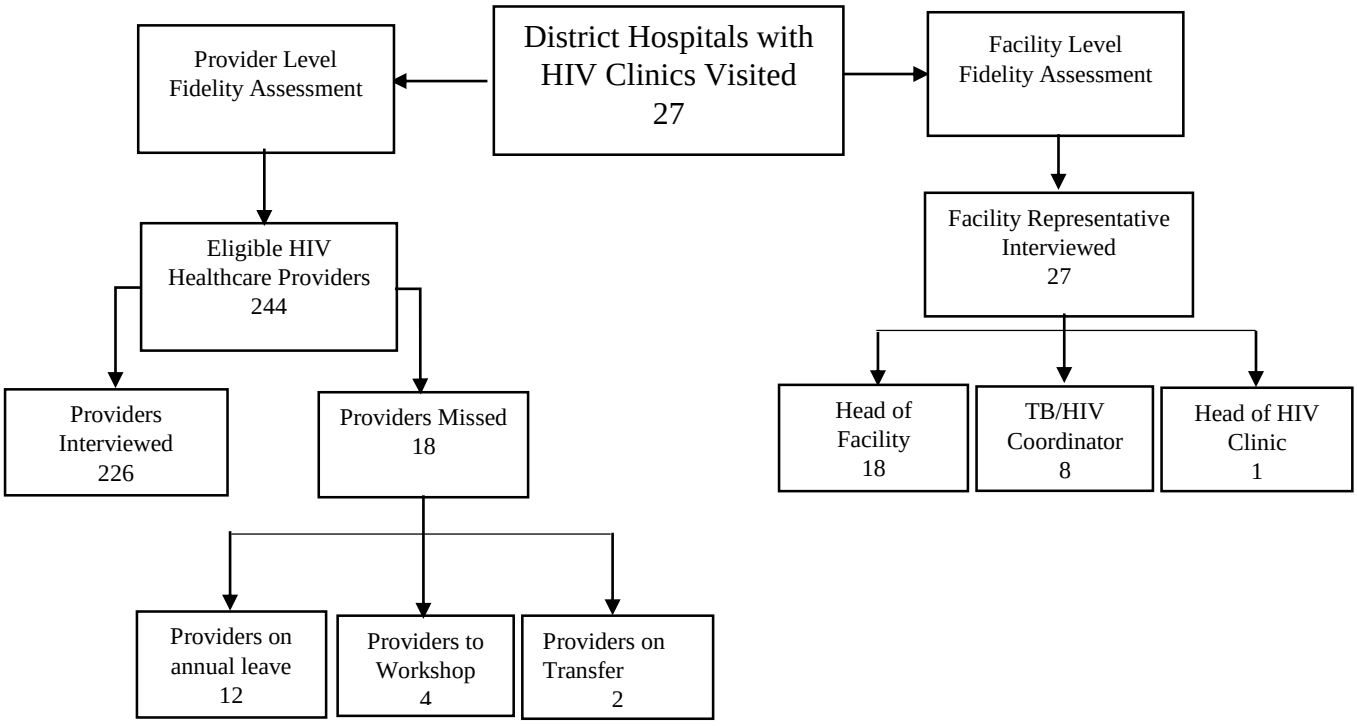


Figure 7: Flowchart of recruitment and study profile of the healthcare providers and facility

Additionally, a data extraction form was developed and used to extract data retrospectively through the review of the HIV clinic records and the TB register to determine coverage of TB screening amongst PLHIV attending the HIV clinic, workload and staffing level per facility. The data was aggregated monthly and covered one year from January to December 2018. The extracted data does not include an identifier or any piece of information that could be used to identify any client.

The data was collected from 9 – 24 April 2019.

3.6.2 Data collection for phase 2 study

Phase 2 of the study was purely qualitative. An in-depth interview (IDI) and focus group discussion (FGD) guide were also developed to collect data to determine the implementation determinants of the intervention. The guides were based on the four identified domains in the CFIR framework applicable to our study. The IDI guide focused on the characteristics of individuals' domains which relates more to the provider level, while the FGD guide also concentrated on the inner setting domain, which relates to the facility level. However, the rest of the other questions on both guides covered the intervention characteristics and outer setting domains. Fact-to-face IDIs were conducted with TB/HIV coordinators and FGDs with HIV healthcare providers. Three field teams (four members per team) worked in one region each to collect data for this study. The teams had five-days of practical training, including role-play on the IDI and FGD guides. The interviews and discussions were conducted in English language and audio-recorded, after which they were transcribed verbatim for analysis. We conducted 17 FGDs with HIV care providers and 8 IDIs with TB/HIV coordinators.

For the data collection, the researcher and the field officers were in the field for almost a month, from 6 - 31 May 2019. In addition, we held earlier discussions with the head of the facilities and heads of HIV clinics to re-explain the purpose of our return to the facility to collect additional data and to ask for permission to conduct the interviews. The providers were recruited with the help of the HIV clinic heads or an appointee by the clinic head in some facilities. The focus group discussion identified between 7 -10 men and women who provide health care to HIV clients at the facility. Each discussion was made up of a moderator, a note-taker/observer, between 7 to 10 participants, and lasted for about 60 minutes.

In their respective offices, TB/HIV coordinators were reached out to ensure privacy and a conducive place for the IDIs. The IDIs lasted for about 30 to 45 minutes.

3.7 Data management, measurement and analysis

The quantitative data were collected utilizing the created semi-structured questionnaires administered to HIV healthcare providers and heads of the facilities or appointed representatives for the study. The data from the providers and heads of the facilities were recorded on the semi-structured questionnaire, whilst the data from the record review was

recorded on a data extraction form. The data collected were peer-certified and corrected by team members for accuracy and consistency, with discrepancies channelled to the researcher daily. The raw data from the questionnaire and the data extraction form were captured using Epidata version 3.1 and Microsoft Excel, respectively, by two data clerks. The data capturing screens had inbuilt checks, which helped manage redundancy in data. All the data were double entered. After all the entries, the datasets were exported into Stata version 15 (Stata Corporation, College Station, Texas) to perform data cleaning and validation to check for other inconsistencies and errors. Those found were corrected using the source documents. All the quantitative analyses were done in Stata version 15 (147).

All the IDIs and FGDs were conducted in English, audio-recorded, and notes were taken alongside the qualitative data. All the audio-recorded interviews were transcribed verbatim. The audiotapes or recordings were listened to and compared with the transcripts and edited. The audio recordings were further used to fill in the notes' gaps. Finally, the data (transcripts) was imported into MaxQDA Analytic Pro software 2020 for analysis.

The summary of the key variables, measurement, approach to analysing various objectives and tests performed is presented in Table 5. Also, subsection 3.7.1 discusses the measurements and analysis of the quantitative data, while 3.7.2 discusses coding and analysis of the qualitative data.

Table 5: variables measured and approach to analysing various objectives

Objective	Key variables, definitions and Measurement	Analysis approach and validation
1. To determine the provider level fidelity to clinical protocols of the intervention among PLHIV attending HIV care clinics in Ghana.	**Provider fidelity**: Extent to which the clinical protocol was implemented by a provider as intended. Measured as 0 = low fidelity level or 1 = high fidelity level. **Content:** the core activities of the intervention performed by providers, measured either as 1=yes, activity performed, 0=no, an activity not performed or scale of 1 – 3 (1=not adherent, 2= partially adherent and 3= fully adherent). **Frequency**: Provider performs activity all the time for all clients. Measured as 1= never, 2=rarely, 3= for some clients sometimes 4=either for all new clients or annually for existing clients, and 5=All the time for all clients.	Descriptive analysis was used. Summation of items and components scores to determine provider fidelity. Cronbach's alpha was calculated for each items, components and overall to check internal consistency of scale used. Median, Inter-quartile ranges (IQR), and percentages were used to present the results. Stata 15 was used for the analysis.
2. To evaluate the influence of moderating factors on provider fidelity of the intervention among PLHIV attending HIV care clinics in Ghana.	**Provider fidelity** level (see key variables under objective 1) **Potential moderators**: Factors applicable to the study identified in CFIF to influence fidelity; facilitation strategy and participants responsiveness (27). Measured with a 3-Likert scale question as: 1. Disagree 2. Neutral 3. Agree **Other factors**: Demographic characteristics of the providers and geo-location of the facility • Age, sex, level of education, years of working, profession an • Location of facility	Descriptive analysis of the moderation factors was conducted to reveal the distribution of the factors among providers. Cluster-based logistic regression was used to determine the influence of the moderation factors according to CFIF on the provider level fidelity. Checked multicollinearity if the moderating factors are correlated with other moderating factors. Control for cluster effect using HIV clinic. Kruskal Wallis tests were conducted. Odds ratio with p-values at 5% confidence interval was used. Stata 15 was used for the analysis.
3. To determine the facility levelfidelity to guidelines of the intervention among PLHIV attending HIV care clinics in Ghana.	**Programme/facility fidelity:** Extent to which the programme guideline of the intervention was implemented at the facility level as intended. Measured as 0 = low fidelity level or 1 = high fidelity level. **Content:** the core intervention activities performed by the facility. Measured as 1=activity implemented, or 0=activity not implemented. **Frequency**: Facility implements activity all the time. Measured on a scale of 1 – 3 (1= HIV clinic provides screening for TB on one day a week to 3= (HIV clinic provides screening for TB on every day of the week). **Coverage:** Review meetings involved all HIV clinic staff. Measurement ranged from 0 (review meeting never include all HIV healthcare providers) to 2 (review meeting always includes all HIV healthcare providers).	A summation of items scores approach expressed as percentage score was used to determine the fidelity level. Descriptive statistics reporting frequencies, percentages, median and interquartile ranges (IQR) were calculated. Reliability and validity test was conducted using Cronbach's Alpha. Median, Inter-quartile ranges (IQR), and percentages were used to present the results. Stata 15 was used for the analysis.

4. To compare the moderating factors by facility levelfidelity of the intervention among PLHIV attending HIV care clinics in Ghana.	**Facility fidelity** (see key variables under objective 3) **Potential moderators**: Factors identified in CFIF to influence fidelity at the facility level. (27). Measured some variables as binary and others as categorical. **Another factor**: Location of the facility	Simple proportions and percentages of moderators were calculated. Spearman's correlation coefficient, Kruskal-Wallis tests Mann-Whitney U test, and were used at a 5% significance level were used to assess for statistically significant differences in Stata 15.
5. To determine an overall implementation fidelity using a composite of provider and facility levelguidelines of the intervention among PLHIV attending HIV care clinics in Ghana.	**Overall/Composite Implementation fidelity**: Extent to which the intervention guidelines for the healthcare providers and facility managers are jointly implemented as intended by NTP. Measured as percentage score per facility using items response scores **Other variables:** Provider level fidelity scores generated from objective 1 Facility levelfidelity scores generated from objective 3	Opportunity-based weight approach Weighted Fidelity Score (WFS) = p*composite provider level fidelity score + (1-p)*composite facility level fidelity score, where p is the weight factor WFS were summarized using descriptive statistics such as medians, IQR, and proportions WFS were compared with TB screening coverage Mann-Whitney test, Kruskal-Wallis test and Spearman's correlation coefficient were used to compare scores across facility factors a 5% significance level Stata 15 was used for the analysis.
6. To explore the determinants of implementation of the intervention among PLHIV attending HIV care clinics in Ghana.	**Determinants of Implementation**: Barriers and facilitators that influence the implementation of the intervention. Key themes of implementation determinants were explored based on the components of the CFIR framework.	The analysis was based on Framework Analysis approach of qualitative data. The six-step method of framework data analysis was used familiarization, assigning codes, searching for patterns, revising the themes, defining and naming themes, and interpretation. Codes were compared for similarities and differences and grouped under either barriers or enablers of implementation. MaxQDA 2020 was used for coding and analysis.

3.7.1 Measurement and analysis of quantitative data

The quantitative data was exported for analysis from EPI-data version 3.1 to the Stata version 15. Proportions, percentages, mean with standard deviation, median with interquartile range (IQR), confidence interval and p-values estimated to establish relationships and describe the distribution of the study outcomes

The expected primary outcomes for the quantitative phase of the study were provider fidelity, **facility** fidelity and composite fidelity to the clinical and programme guidelines of the intervention. The secondary outcomes were moderating factors related to provider and facility fidelities.

3.7.1.1 Provider implementation fidelity analysis

A total of 19 critical items covering content and frequency domains of adherence in the CFIF were identified in the TB screening guideline to assess provider implementation. The items with varying measurements are presented in Table 6.

Table 6: List of the 19 items and their measurement for assessing provider implementation fidelity

Content items		**Frequency items**	
Description ***(variable name)*** ***Response:*** No…..0 Yes….1	**Mean**	**Description** ***(variable name)*** ***Response:*** 1 = Never 2 = Rarely 3 = For some clients sometimes 4 = Either for all new clients or annually for existing clients 5 = All the time for all clients	**Mean**
Component 1: TB diagnosis			
Asks client about cough of any duration.	0.863	How frequently do ask PLHIV about cough of any duration during consultation?	4.257
Asks if the client has night sweats.	0.686	How frequently do you ask PLHIV about night sweats during consultation?	3.580
Asks if the client had fever.	0.619	How frequently do you ask PLHIV if they had a fever during consultation?	3.553
Asks if the client has pain in the chest.	0.748	How frequently do you ask PLHIV about pain in the chest during consultation?	3.823

Asks/checks if the client lost weight.	0.673	How frequently do you ask/check the weight of PLHIV during consultation?	3.336
Component 2: TB awareness			
Provides education.	0.659	How frequently do you provide education for PLHIV?	3.385
Provides counselling about TB screening.	0.726	How frequently do you provide counselling about TB screening for PLHIV?	3.695
Component 3: TB symptoms questionnaire			
Uses TB screening questionnaire (clinical algorithm).	0.730	How frequently do you use the TB screening questionnaire for PLHIV?	3.668
Component 4: TB screening process			
Do you ask all the HIV clients all the TB screening questions?	0.664		
After screening the client for TB, what do you do next? ^ 1=No adherent 2=Partially adherent 3=fully adherent			2.0
If you identify a client who you presumed of having TB, what steps would you take? ^ 1=Not adherent 2=Partially adherent 3=fully adherent			1.650

Note: ^Open-ended questions. The means of each items were computed based on the responses from the providers to give prior information on each items prior to further analysis.

Regarding our knowledge and experience, we regrouped the critical items into four main components (Table 6). Each of the components, as presented below, were made up of different items that would attain the objective of the program when implemented as is. These components are as follow:

1. *TB diagnosis* through screening for signs and symptoms of TB among all PLHV at all HIV clinics during every visit.
2. *TB Awareness* through health education on TB and counselling of all HIV clients at every HIV clinic visit.
3. *TB symptoms questionnaire* to screen all HIV clients for TB at all HIV clinics.
4. *TB screening process* which entails providers' knowledge of the processes of early diagnosis and treatment of HIV-associated TB at the HIV clinic.

More detail is available in the provider level fidelity paper under Chapter 4 of this thesis.

3.7.1.2 Programme/facility implementation fidelity analysis

A total of 18 items were identified from the intervention guideline to determine programme implementation fidelity, with a total possible maximum score of 29. The items were similarly grouped into four components. The four components of programme implementation fidelity identified from the implementation guideline had different numbers of items and varied maximum scores for each component, as shown in Figure 8

1. *Intensive TB case-finding among PLHIV (ITCF)* through the HIV clinic by screening all PLHIV attending HIV clinic for TB, conducting TB evaluation and the extent to which there was regular or routine delivery of these activities as required by the guidelines;
2. *IPT initiation (IPT)* in specialized cases is recommended by clinicians. These include children under 5 years who are exposed to people with active TB and persons with immunosuppression as a result of chemotherapy, prolonged steroid use and persons on renal replacement therapy (76);
3. *TB infection control (TIC)* to prevent the spread and increase of TB in the facility through activities such as having a TB infection control plan, a mandatory examination of all health workers for TB and administrative, environmental and personal protection control; and
4. *Programme review meeting (PRM)* to be conducted monthly to involve all the HIV clinic staff discussing issues with quality data sharing and feedback.

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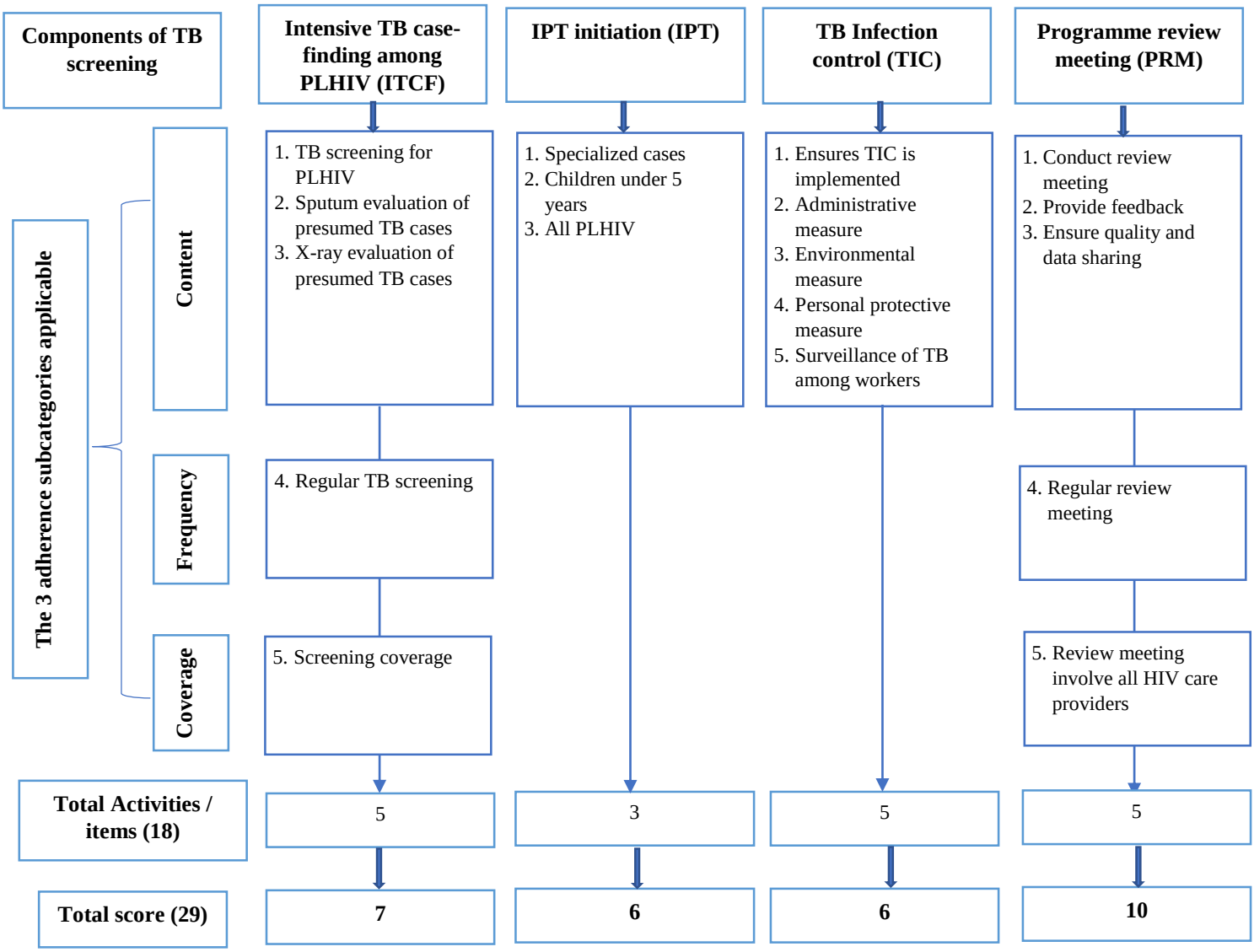


Figure. 8: TB screening activities and scores by components to asses programme implementation fidelity

More detail is available in the facility level fidelity paper under Chapter 5 of this thesis.

3.7.1.3 Combined implementation fidelity of the delivery analysis

The critical items covering provider and facility levels were combined to determine an overall fidelity of implementation of the intervention. The opportunity-based weight approach (148) was adopted and used to determine the weighted fidelity score.

More detail is available under Chapter 7 of this thesis.

3.7.1.4 Moderating factors of implementation fidelity analysis

Two major secondary analyses were performed with quantitative data. That's comparing and assessing moderating factors of fidelity levels at the facility level and at the provider level, respectively. Proportions, chi-square, odds ratios and p-values at 95% confidence interval were calculated.

More detail is available under Chapters 4, 5 and 7of this thesis.

3.7.1.5 Statistical tests

Statistical tests were performed for all the quantitative analyses. Refer to chapters 4, 5 and 7 for the different and specific tests performed. However, internal consistency and reliability checks using Cronbach's Alpha were confirmed before assessing the fidelities.

3.7.2 Analysis of qualitative data

We analysed the qualitative data to identify influencing factors of the implementation of the intervention at the facility point. The transcribed data were analysed deductively through the thematic approach in MaxQDA version 2020. The approach which is widely used among health researchers (149) included the six iterative steps been familiarization with the data, generating initial codes or assignment of primary codes to the dataset to describe the content, searching for patterns and codes across the different interviews, themes revision, themes definition and naming and producing the report through the interpretation of results. The Consolidated Framework for Implementation Research (CFIR) was used as a guide to efficiently and rigorously analyse the data.

Details on the qualitative analysis can be found in chapter 6 of the thesis.

3.8 Quality control

To ensure the study was conducted well, quality control measures were applied throughout the entire processes and phases of the research. Experienced supervisors reviewed the protocol and

tools for the data collection, researchers and subject matter experts reviewed to ensure reliability, consistencies and validity. All the tools were pre-tested in settings similar in characteristics to the study area.

The 12 field officers who collected the research data were extensively trained for five days on issues concerning the study. The 2 data clerks were trained on the screen for two days to capture the data and inbuilt checks. The study teams held debriefing meetings remotely after every day's work with the research to correct and identify emerging themes (phase 2) that were worth exploring in the subsequent day's work.

3.9 Ethical considerations

3.9.1 Ethical approval

The study obtained ethical approvals from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand in Johannesburg, South Africa (Wits HREC) and the Ghana Health Service Ethical Review Committee (GHS-ERC) in Accra, Ghana. The clearance certificate number obtained from Wits HREC was M190110, whilst GHS-ERC was GHS-ERC002/01/19.

Prior discussions were held with the National Tuberculosis Control Programme of Ghana to describe the purpose and rationale of the study and sought the support of the programme. The programme, therefore, agreed, collaborated and supported by providing an introductory letter to all the 10 Regional Health Directorate (RHD) of the Ghana Health Service. Written permissions were obtained from the Regional Health Directorates, and verbal permissions were sought from the District Health Directorates and the District hospitals where the study was conducted. All the participants interviewed gave informed consent before participating in the study. Permission was sought before all audio recordings.

All participants were given the option to withdraw from the interview or refuse to respond to any question if they felt so at any time in the course of the interview or discussion with the assurance that it will not affect them as care providers with the Ghana Health Service. The results of the study will be presented to the NTP at the annual meeting, where heads of the directorates and TB/HIV coordinators will be present

3.9.2 Informed consent

All the participants by themselves gave written informed consent before they participated in the study. The information sheet contained the justification for the study, processes, expected benefits and potential hazards of the study. This was in the English language. Permission was also obtained from all the heads of the units where the study participants belonged.

3.9.3 Confidentiality

The district hospitals were identified using study codes generated by the researcher. All records of study participants were assigned study numbers. The IDI and FGD participants were assigned numbers and linked to their respective facility codes. All publications and the report were de-identified to preserve the privacy of research participants.

3.10 Protocol amendments

We noticed two different titles on our important documents, one of which is more appropriate for the study. We have therefore applied to faculty and had obtained approval for change of title. The current title is the revised one for the thesis which links well the aim and objectives of the study. Please refer to Appendix F for a copy of the approval.

4.0 Provider-level Implementation Fidelity to TB Screening Guidelines

This chapter is a result chapter of paper 1 with the original paper attached as appendix A. Paper 1 presents findings covering objectives 1 and 2 of the study and describes under the chapter the background of the paper, methods results and discussion sections. It looked at the fidelity level among providers to the intervention and examined its related factors. The results depict the extent to which the various component of activities for the provider in implementing the intervention was adhered to by the providers at the HIV clinics. Paper 1 also depicts which provider-level factors influences the provider level fidelity to the intervention.

4.1 Abstract

Introduction. Tuberculosis screening of people living with human immunodeficiency virus is an intervention recommended by the WHO to control the dual epidemic of TB and HIV. The extent to which the intervention is adhered to by the HIV healthcare providers (fidelity) determines the intervention's effectiveness as measured by patient outcomes, but literature on fidelity is scarce. This study assessed provider implementation fidelity to national guidelines on TB screening at HIV clinics in Ghana.

Methods. It was a cross-sectional study that used structured questionnaires to gather data, involving 226 of 243 HIV healthcare providers in 27 HIV clinics across Ghana. The overall fidelity score comprised sixteen items with a maximum score of 48 grouped into three components of the screening intervention (TB diagnosis, TB awareness and TB symptoms questionnaire). Simple summation of item scores was done to determine fidelity score per provider. In this paper, we define the level of fidelity as low if the scores were below the median score and were otherwise categorized as high. Background factors potentially associated with implementation fidelity level were assessed using cluster-based logistic regression. Odds ratio with 95% confidence interval (CI) was used as the measure of association.

Results. Of the 226 healthcare providers interviewed, 60% (135) were females with a mean age of 34.5 years (SD=8.3). Most of them were clinicians [63% (142)] and had post-secondary non-tertiary education [62% (141)]. Overall, 53% (119) of the healthcare providers were

categorized to have implemented the intervention with high fidelity. Also, 56% (126), 53% (120), and 59% (134) of the providers implemented the TB diagnosis, TB awareness and TB symptoms questionnaire components respectively with high fidelity. After adjusting for cluster effect, female providers (AOR=2.36, 95%CI: 1.09–5.10, p=<0.029), those with tertiary education (AOR=4.31, 95%CI: 2.12–9.10, p=0.040), and clinicians (AOR=1.78, 95%CI: 1.07–3.50, p=0.045) were more likely to adhere to the guidelines compared to their counterparts.

Conclusion. The number of providers with fidelity scores above the median was marginally greater (6%) than the number with fidelity score below the median. Similarly, for each of the components, the number of providers with fidelity scores higher than the median was marginally higher. This could explain the existing fluctuations in the intervention outcomes in Ghana. We found gender, profession and education were associated with provider implementation fidelity. To improve fidelity level among HIV healthcare providers, and realize the aims of the TB screening intervention among PLHIV in Ghana, further training on implementing all components of the intervention is critical.

Keywords. Implementation fidelity levels, adherence level, guidelines, HIV clinics, healthcare providers, TB/HIV, implementation science, sub-Saharan Africa, Ghana.

4.2 Introduction

Globally, tuberculosis (TB) disease is known to be the main cause of death among people living with HIV (PLHIV) [1]. PLHIV are more likely to succumb to TB diseases than people without HIV due to their compromised immune system. Intensified TB case-finding through TB screening of PLHIV is one of the World Health Organization (WHO) policies emphasizing TB and HIV collaborative activities as a means to reducing the dual burden of TB and HIV [2,3]. Effective TB screening of PLHIV ensures early identification of those with presumptive TB infection who requires a confirmatory test through X-ray or genXpert for appropriate treatment [1]. The early detection helps to identify TB cases and ensures the separation of cases from non-cases to reduce the TB transmission in PLHIV [1].

The National TB Control Programme (NTP) in Ghana, like many other countries where HIV and TB are of public health concern, adopted and implemented the policy on TB screening of

PLHIV in 2004 [2,4]. PLHIV who attend HIV clinics should be systematically and routinely screened for TB at every visit using the WHO-approved screening questionnaire for the presence of cough of any duration, fever, weight loss and night sweats [5]. PLHIV with the presence of one or more of these symptoms have a confirmatory test (X-ray/XpertMTB/RIF) and then appropriate preventive or curative treatment depending on the result [3]. Although the intervention (TB screening of PLHIV) was implemented over a decade ago [6] the proportion of PLHIV screened had not been stable – declines and fluctuates over time [7]. In the early years of the implementation, the proportion of PLHIV screened for TB was about 70-96% [7]. But this fluctuated as the years progressed, with about 80% of PLHIV in 2013 [7] and 41% in 2014 [8] not screened for TB. This led to a review of the policy in 2014 with new screening targets set at 56% for 2015, and progressively increasing the target to 80% in 2018 and 90% in 2020 [7]. In 2018, 44000 TB cases and 15,800 TB deaths were recorded with an estimated incidence rate of 148 per 100,000 population [9]. Also, according to the WHO global TB report (2020) [10] out of 35,424 newly enrolled person in HIV care in Ghana, 2620 (7.4%) were notified as TB cases.

Intervention implementation under real-life conditions is known to be complex and influenced by different factors [11–13]. The implementation science (IS) literature posits that interventions of proven effectiveness may fail to yield intended outcomes due to challenges related to the implementation of the intervention in real-world settings [14–17]

Some researchers postulate that interventions yield the desired outcome if the implementation is effective [17–19]. One of the ways to measure implementation effectiveness is to assess what is referred to in IS as implementation fidelity (IF) (that is the degree to which the intervention is being implemented by healthcare providers as intended by the designers of the intervention) [20– 24]. Some researchers have conceptualized how different factors act or interplay to influence the implementation programme [12,14–16,25,26]. Carrol et al 2007 [24] developed a comprehensive framework outlining the components of implementation fidelity as adherence covering activities of content, coverage, frequency and duration. It also outlined that the level of implementation fidelity may be influenced by factors called moderators subcategorized as intervention complexity, facilitation strategies quality of delivery, and participant's responsiveness. They emphasized that IF is the same as adherence and so therefore, the assessment of IF is tantamount to adherence assessment. It is argued that any of these fidelity components alone, or a mix depending on the intervention and the guideline, could be used to

measure implementation fidelity [21,27]. But the mix must show consistency in dimensionality (number of attributes of a dataset for an outcome), reliability (produce the same finding under similar situation) and validity (measures what it is intended to) through the use of an empirical method of analysis such as structural equation modelling, factor analysis and principal component analysis [28,29], summation of items/activities/component scores [30]. These analytic techniques are helpful to researchers in determining the best combination of items. Interventions are aided with policy or programme guidelines based on both theoretical and empirical grounds. These guidelines contain the core components of the intervention without which the intervention cannot operate effectively to achieve the intended outcome [31,32].

Many studies have been conducted on IF from different disciplines [33]; in education [34], social work [35], engineering [36], construction [37] and health [16,38,39], the area of this study. IF is important in the process of translating evidence-based interventions into real-life practice. This means, whether an intervention is implemented within the health sector according to design, for instance, has repercussions on whether that intervention will achieve in the population the health outcomes observed in the clinical trials [15,19]. However, there is a dearth of research on the fidelity of implementation of the TB screening intervention among PLHIV in Ghana or elsewhere. Most studies conducted in this area are focused on screening coverage [40–42]. Another one was a before-and-after study that assessed the impact of integrating TB and HIV services on TB treatment outcomes and explored the usefulness of TB treatment outcomes as TB/HIV indicators [43]. Whether and the extent to which the TB screening intervention among PLHIV is being implemented would have an impact on the coverage of this intervention among PLHIV (service outcome) and ultimately the burden of TB among PLHIV (health outcome). However, no study has been conducted in Ghana to assess IF as a possible reason for the observed low and fluctuating screening coverage outcomes since the implementation of the intervention. This study, therefore, assessed the level of provider IF to TB screening among PLHIV attending HIV clinics in Ghana as well as factors associated with IF level.

Conceptual framework: the conceptual framework for implementation fidelity

Many frameworks have been developed for assessing IF. Where applicable, some studies combine adherence and competence to assess IF [38,44,45] while **other** studies assessed only adherence and consider competence as a moderating factor [46,47]. Having identified

adherence as our focus of assessing IF for this study, we adapted Carroll *et al*. Conceptual Framework for Implementation

Fidelity (CFIF) [24] because it harnessed other frameworks and is a comprehensive and useful way of assessing IF [12]**.** Carroll et al. [24] reviewed existing theories and frameworks of IF and developed the CFIF with constructs guiding the assessment and understanding of implementation fidelity. The framework was made up of five elements; adherence, dose, quality of delivery, participant responsiveness, and programme differentiation. The framework suggested that the measurement of adherence (content, frequency, duration and coverage) to the intervention is IF. It considers the rest of the elements as moderating factors of fidelity level achieved. The desired outcome of TB screening depends largely on how well the intervention is implemented. The final implementers of the intervention were the providers at the HIV clinics.

We, therefore, adapted and drew conceptual inspiration from CFIF to assess IF for this study at the provider level. According to Carroll et al. [24], successful implementation can only result if the essential components of the intervention are identified and implemented as planned. The identification offers the opportunity for adaptation. Clinical guidelines outlining what the healthcare providers are expected to do in terms of TB screening among PLHIV exist [2,3,7]. In adapting the CFIF to measure IF, we reviewed the TB screening guideline among PLHIV and identified essential components. These components were grouped under content and frequency sub-constructs of adherence.

The level of IF is influenced by the relationship between other factors and the essential components of the intervention identified. In our study, the IF could potentially be influenced by an interaction between those essential components and critical characteristics such as contextual factors (regional location of the HIV clinic) and the provider characteristics. They are widely considered critical because they influence attitude and motivation which eventually affects behaviour. Based on the concept of the framework, we finally decided to examine the influence of these critical characteristics on IF as depicted in Figure 9. The broken line in Figure 9 shows that the connection between TB screening among PLHIV and its outcomes is external to IF, but that the degree of IF attained can alter this relationship.

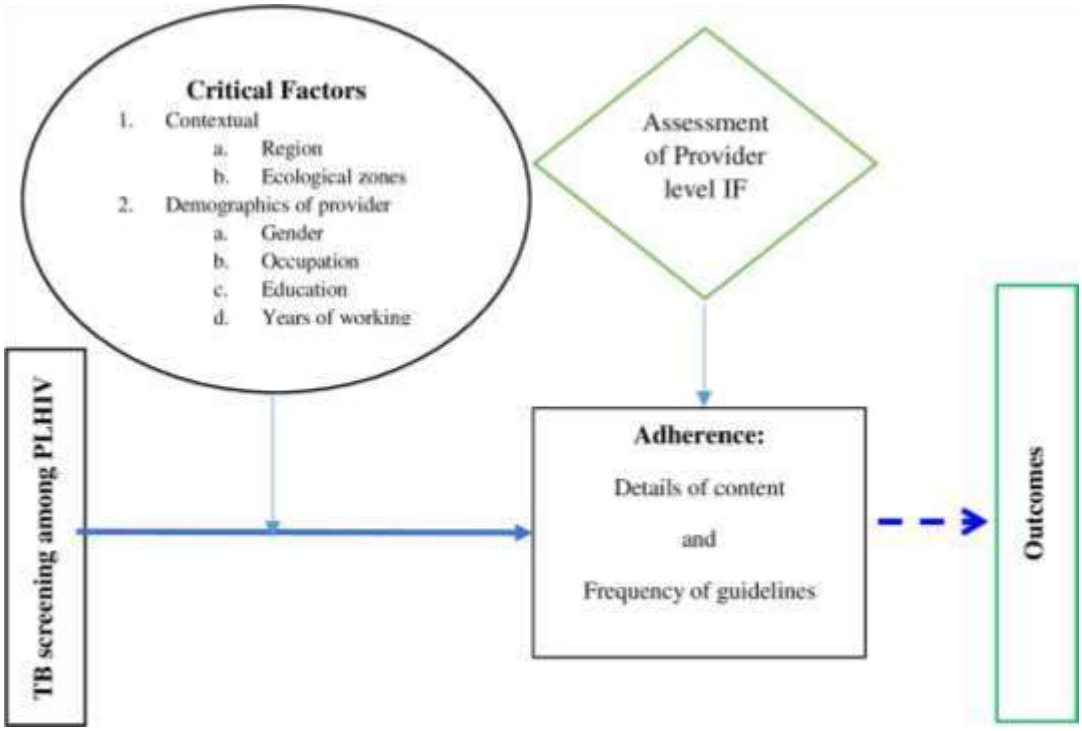


Figure 9: A conceptual framework for provider level IF to TB screening at HIV clinics in Ghana: adapted from CFIF by Carroll et al, 2007

The details of content and frequency sub-constructs used in this study are defined as below:

1. Content – the degree to which healthcare providers at the HIV clinic follow the intervention guideline, e.g. providing important counselling and education, screening, referral, and appropriate treatment
2. Frequency – the extent to which healthcare providers at the HIV clinic perform the activities on the guideline according to the prescribed frequency, e.g. how often does the HIV care provider conducts counselling, education, use the TB screening tools among PLHIV; which must be conducted all the time for all clients seen.

4.3 Methods

Ethics statement

Protocol approvals were obtained from both the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg, South Africa (Clearance number M190110) and the Ghana Health Service Ethical Review Committee (GHS-ERC), Accra, Ghana (clearance number GHS-ERC002/01/19). All participants in the study gave written consent.

Study site

Ghana administratively is made up of 10 regions subdivided into 216 districts in 2017. Out of the 216 districts, 140 have district hospitals. This study was conducted in 27 HIV clinics located within 27 district hospitals across the 10 regions. These 27 district hospitals have and mandatorily run HIV clinics daily on all the 5-working days of the week. These district hospitals were chosen for this study because as part of care, the NTP identified these 27 district hospitals with both X-ray machines and geneXperts for TB confirmatory tests as the first sites to begin the implementation of isoniazid preventive therapy (IPT) for screened PLHIV who tested negative for TB.

The regional distribution of these hospitals are Volta 1; Upper West, Northern, and Greater Accra with 2 each; Brong Ahafo, Central, Upper East and Western with 3 each and Eastern and Ashanti with 4 each as shown on the map of Ghana (Figure 10).

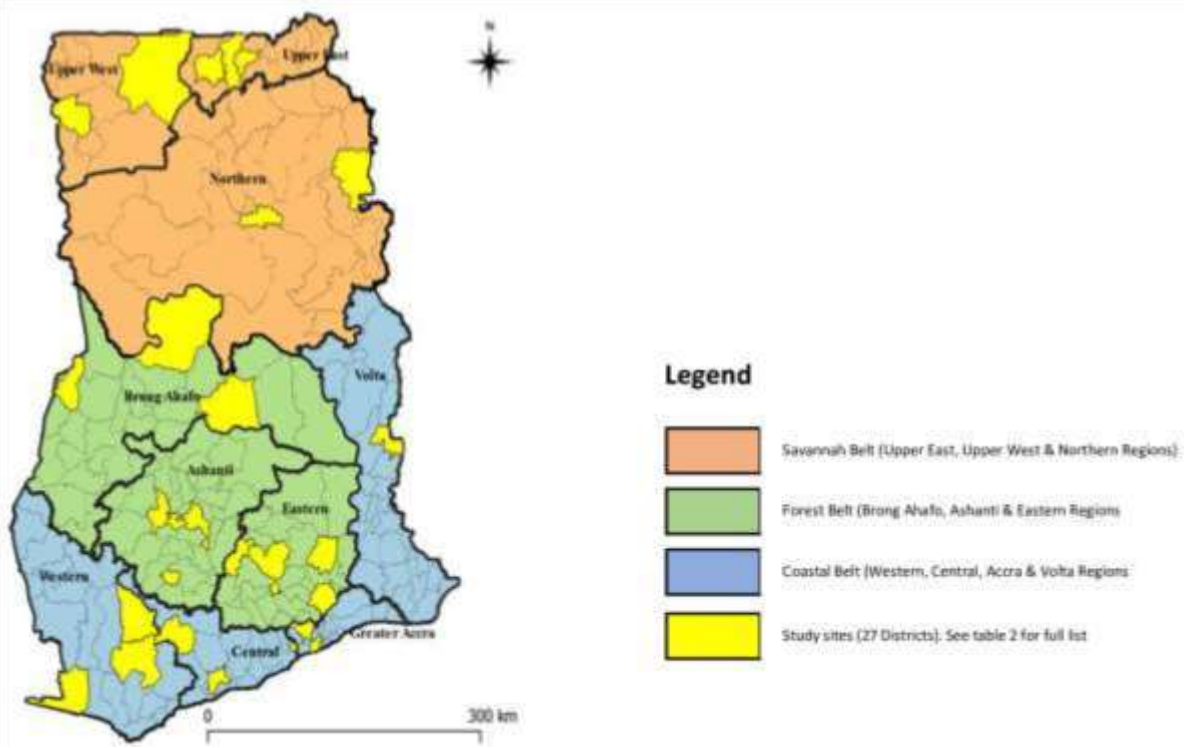


Figure 10: A map of Ghana showing the 10 regions and the study sites

Among PLHIV, preventing TB involves the three 'I's: Intensified case finding, Isoniazid Preventive Therapy (IPT), and Infection Control for TB including early initiation of ART. At the HIV clinic within the district hospital, trained healthcare providers (clinical and non-clinical) guided by the guidelines for TB preventive therapy in Ghana provide TB preventive services to PLHIV attending the clinic. At every visit, PLHIV are given TB counselling and screening using TB symptom screening questionnaire. Based on the client response to the signs and symptoms (cough of any duration, night sweat, chest pain, weight loss or fever) providers had to refer client to for GenXpert or X-rays confirmation test. If *Mycobacterium* TB is detected, providers initiate anti therapy appropriately, otherwise they initiate TB preventive therapy based on TB expert evaluation.

Unlike other sectors like education, construction, and engineering, the health sector at the district hospital level (Fig 3) for instance had intervention guidelines for *(1)* management at facility or facility leveland *(2)* providers who are the direct implementers of the intervention to participants. The structure in Figure 11 refers to the arrangement or formation at the hospital.

All the providers at the HIV care clinics were equipped to screen PLHIV for TB. The NPT ensured that all HIV clinics staff had engaged in either a pre-service, in-service, and or continuing professional development and specialization course training on TB and HIV issues including TB screening. These providers include clinicians (provide direct care to patients, e.g. nurses and physicians) and non-clinicians (support patient care, e.g. disease control, task-shifting, health promotion, and nutrition officers). Therefore both the clinicians and non-clinicians at the HIV clinic trained on TB collaborative activities are required to provide TB and HIV counseling, conduct TB screening with the TB screening questionnaire, administer ARV, and provide other TB related activities among PLHIV at HIV clinics. Non-clinicians exclude laboratory and pharmacy staff who might have received trainings on TB related activities but do not do TB screening.

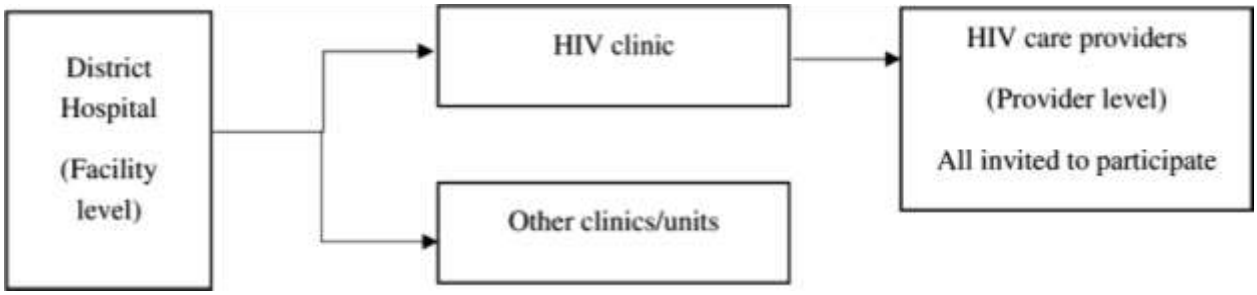


Figure 11: A typical structure of district hospital depicting where facility and provider levels belonged

Study design and sampling

A total of 27 HIV clinics within the identified 27 district hospitals with both the X-ray machines and geneXperts for TB confirmatory tests were surveyed for the study.

The study was cross-sectional that used a census-based survey to interview all the providers at the 27 HIV care clinics. This census-based method was applied to achieve a good number of participants to conduct a meaningful analysis of the study. To maximize representation and ensure all providers involved in doing TB screening at the clinic participated in the study, the number of providers per clinic was established with an effort to include everyone in the study. Staff and other healthcare providers who did not work directly with the HIV clinic were excluded.

Data collection

A questionnaire was developed and used to collect data from the participants. The structured questionnaire collected data on the demographic characteristics of the provider, and data on their reported adherence to the clinical guidelines on screening of PLHIV, focusing on contents and frequency of the intervention implementation. Prior information and knowledge from the TB/HIV collaborative protocol guideline by the Ghana NTP [6] together with the CFIF guided the measurement approach. The provider-level fidelity questionnaire was developed based on the key elements or activities in the guidelines for the provision of TB screening among people living with HIV attending the HIV care clinic. The questionnaire focused on the main activities directly relating to TB screening by the providers, as documented in the guideline. A total of 19 questions were formulated from these main activities and as mentioned earlier was part of the pretest during the research assistants training.

As with many other healthcare surveys [48,49], most of the questions were formulated on different point-Likert scales depending on what it sought to measure [50]. Table 7 presents a list of questions as outlined in the TB screening guideline and grouped under each of the content and frequency sub-elements and how they were measured.

Table 7: List of the 19 items used to determine provider implementation fidelity score

Content items		**Frequency items**	
Description ***(variable name)*** ***Response:*** No…..0 Yes….1	**Mean**	**Description** ***(variable name)*** ***Response:*** 1 = Never 2 = Rarely 3 = For some clients sometimes 4 = Either for all new clients or annually for existing clients 5 = All the time for all clients	**Mean**
Component 1: TB diagnosis			
Asks client about cough of any duration.	0.863	How frequently do ask PLHIV about cough of any duration during consultation?	4.257
Asks if the client has night sweats.	0.686	How frequently do you ask PLHIV about night sweats during consultation?	3.580

Asks if the client had fever.	0.619	How frequently do you ask PLHIV if they had a fever during consultation?	3.553
Asks if the client has pain in the chest.	0.748	How frequently do you ask PLHIV about pain in the chest during consultation?	3.823
Asks/checks if the client lost weight.	0.673	How frequently do you ask/check the weight of PLHIV during consultation?	3.336
Component 2: TB awareness			
Provides education.	0.659	How frequently do you provide education for PLHIV?	3.385
Provides counselling about TB screening.	0.726	How frequently do you provide counselling about TB screening for PLHIV?	3.695
Component 3: TB symptoms questionnaire			
Uses TB screening questionnaire (clinical algorithm).	0.730	How frequently do you use the TB screening questionnaire for PLHIV?	3.668
Component 4: TB screening process			
Do you ask all the HIV clients all the TB screening questions?	0.664		
After screening the client for TB, what do you do next? ^ 1=No adherent 2=Partially adherent 3=fully adherent			2.0
If you identify a client who you presumed of having TB, what steps would you take? ^ 1=Not adherent 2=Partially adherent 3=fully adherent			1.650

Note: ^Open-ended questions. The means of each items were computed based on the responses from the providers to give prior information on each items prior to further analysis.

Data collection was conducted by four teams of research assistants comprising three members each. Research assistants were trained for 5 days with the fifth day used for pretesting the tools. The tools were pretested in two similar HIV clinics to ensure that measurement errors and respondent burdens are minimized and to point out problem areas for rectification. The teams collected the main data only on weekdays from 9th April to 24th April 2019 (12 working days).

Each team visited a facility for at least five working days. Follow-ups/return visits were made for 4-days while the team was still within the facility such that every participant could be interviewed. In the end, a total of 244 healthcare providers from the 27 district hospitals across the country were established as potential participants at the HIV clinics. We interviewed 226 participants, with the number of healthcare providers interviewed per clinic ranging from 6 to 12 as shown by the flowchart of the recruitment and study profile (Figure 12).

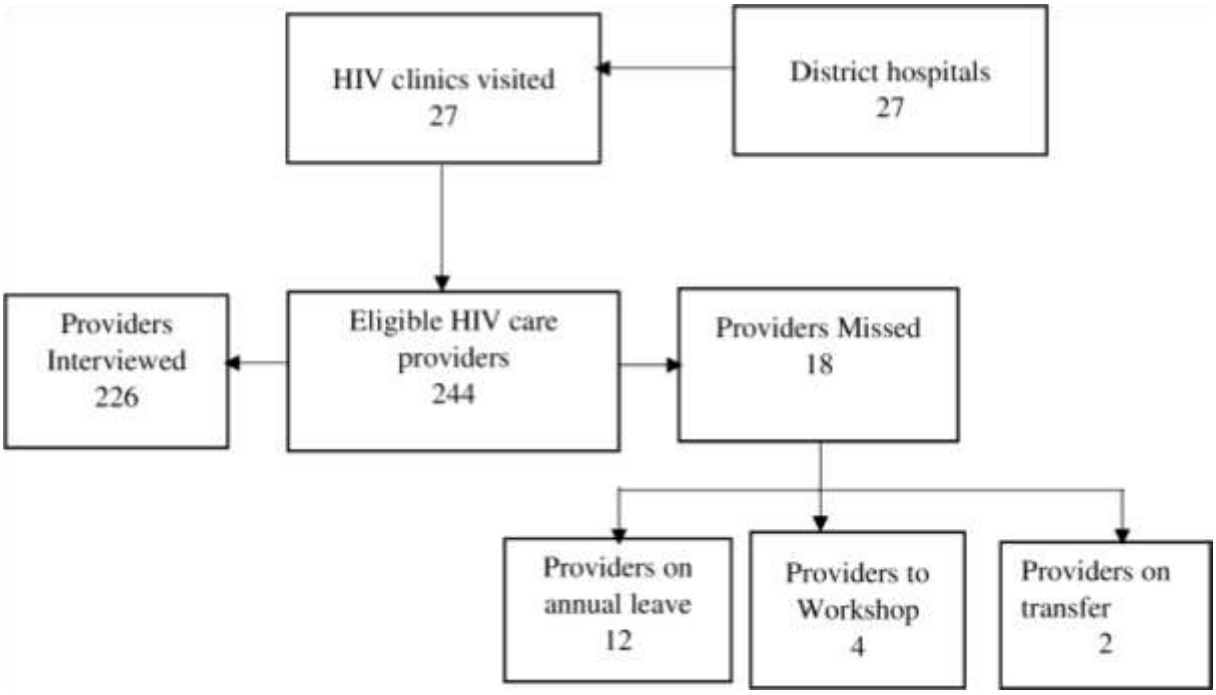


Figure 12: Flowchart of recruitment and study profile of the healthcare providers at the HIV clinics

Data management and analysis

An EPIDATA version 3.1 software was use to capture the collected data which based on hardcopy questionnaire and further imported into Stata 15 for cleaning and analysis.

Questions covering content were measured by *1= yes,* meaning the activity was performed or provided and *0 = no,* meaning the activity was not provided or performed. Other items under this construct were open-ended questions at the time of the data collection. They were post-coded later with a scale of 1 to 3 indicating the degree to which the provider's response reflected adherence to what is in the intervention guideline *(1 = not adherent; 2= partially adherent and 3=fully adherent).* The frequency components of the questionnaire were measured on a scale of 1 to 5 *(1= never, 2=rarely, 3= for some clients sometimes 4=either for all new clients or annually for existing clients, 5=All the time for all clients),* with a scale 5 being what the intervention guidelines expected.

We first had to determine the level of implementation fidelity from the questions/items covering content and frequency and the further identify associated provider characteristics. The questionnaire items – which were selected from the guideline – had never been used to measure fidelity anywhere and as such, there was no reference for what would constitute high or low

fidelity. There was therefore a need to identify the set of items or variables underlying the plausible factors or components required to measure provider implementation fidelity to the TB screening intervention guidelines. Since there was no existing study on how different items, number of items and components relate to one another to help us determine the fidelity level, we proceeded to arrive at a parsimonious representation of the associations among our measured variables. In order to do so and find the underlying variables for measuring fidelity to the guidelines on TB screening of PLHIV at HIV clinics, the exploratory factor analysis (EFA) method using polychoric correlations matrix technique was initially employed. On applying the EFA, we found that the factor loadings and unique variances were very low as expected but three of the 19 items. The factor analysis was however not value-adding as there was no apparent significant variable reduction. Therefore, the original items were instead used for further analysis.

As a result, we re-grouped the original items selected from the TB screening guideline into four main components based on our knowledge and experience. Each of the four components has different items that must be implemented to achieve the purpose of the TB screening intervention among PLHIV. These components are as follows:

1. *TB diagnosis* through screening for signs and symptoms of TB among all PLHV at all HIV clinics during every visit.

2. *TB Awareness* through health education on TB and counselling of all HIV clients at every HIV clinic visit.

3. *TB symptoms questionnaire* to screen all HIV clients for TB at all HIV clinics.

4. *TB screening process* which entails providers' knowledge of the processes of early diagnosis and treatment of HIV-associated TB at the HIV clinic.

Each of the four components of the intervention is made up of between two to ten items as outlined in the guideline for implementation of TB/HIV collaborative activities [51]. Among the 19 items identified items, the TB diagnosis component comprises 10; TB awareness 4; TB symptoms questionnaire 2; and TB screening process 3 items.

To proceed with assessing the provider fidelity level, we conducted an internal consistency and reliability check to ensure that the various items are suitable to measure each of the four components. The Cronbach Alpha which measures the internal consistency (the extent to which

the items in a test measure the same component) of a scale [52] was used. A calculated alpha closer to one showed items measure the component well. The calculated alpha was high (approximately 0.900) for TB diagnosis, TB awareness, and TB symptoms questionnaire components except the TB screening process with an alpha score of 0.423. The TB screening process component was therefore excluded from the analysis based on it low alpha value [52]. The Cronbach Alpha calculated for all the items from the three components (TB diagnosis, TB awareness, and TB symptoms questionnaire) showed that the data seem to fit well (Alpha=0.915) in the scale in all aspects to enhance the accuracy of overall provider fidelity level assessment.

We carried out the analysis on the three components and their respective items. Based on the various scoring for each item, the total maximum possible score was 48 (16 items) per provider (TB diagnosis 30; TB awareness 12; and TB symptoms questionnaire 6). Item scores for each component were summed to determine component-specific fidelity scores for each HIV care provider. An overall provider implementation fidelity level was then determined by summing items scores of all the three components.

The scores of the three components and the overall were converted to proportions based on the respective total maximum possible score and summarized using Median, Inter-quartile ranges (IQR), and percentages. These scores were measuring extent of fidelity and compared across geographic location of the health facility and provider characteristics using the Kruskal Wallis and Chi square tests.

Reference point regarding what constitutes a high level of provider implementation fidelity to TB screening among PLHIV is unknown. To aid interpretation of the fidelity scores, we arbitrarily used the median fidelity score computed from this study as a cut-off, since our data was not normally distributed. Therefore we grouped as low fidelity those providers whose fidelity scores were below the median and as high fidelity those whose fidelity scores were equal or above the median fidelity (coded as *0=low provider fidelity level* and *1=high provider fidelity level*).

A descriptive analysis on the participants' characteristics and levels of fidelity was conducted.

Logistic regression (LR) was used to examine for association between the IF level and characteristics of the healthcare provider adjusting for the district hospital (random) effect.

Statistical significance was considered at 5% level. The variance inflation factor (VIF) calculated to measure the amount of multicollinearity in the regression variables ranged between 1.02 and 1.34 (mean VIF=1.18), which indicates no correlation between the variables. All the analysis were performed using the Stata 15 software [53].

4.4 Results

Descriptive analysis

Characteristics of healthcare providers

The study profile (Fig 4) showed that 226 HIV care providers participated in this study. The result from descriptive analysis (Table 8) found that out of the 226 healthcare providers interviewed, about 60% (135) were females. The mean age of the providers was 34.5 years (Standard Deviation [SD] =8.3) and 65% (147) providers have worked in the HIV clinic for less than 5 years. The results also showed that 63% (142) of the providers were clinicians whilst 62% (141) had attained a post-secondary non-tertiary level of education.

Table 8: Characteristics of the healthcare providers by profession at the HIV clinics in Ghana, 2019

Characteristics of providers	Clinicians n (%)	Non-clinicians n (%)	All providers n (%)
Age in completed years, Mean (SD)	34.6 (9.1)	34.3 (7.0)	34.5 (8.3)
Gender			
Female	109 (76.8)	26 (30.9)	135 (59.7)
Male	33 (23.2)	58 (69.1)	91 (40.30)
Years working in HIV care clinic			
<5years	102 (71.8)	45 (53.6)	147 (65.0)
5years plus	40 (28.2)	39 (46.4)	79 (35.0)
Highest educational level			
Upper secondary	5 (3.5)	5 (5.9)	10 (4.4)
Post-secondary non-tertiary Tertiary	108 (76.1) 29 (20.4)	33 (39.3) 46 (54.8)	141 (62.4) 75 (33.2)
Total	**142 (100)**	**84 (100)**	**226 (100)**

Among the clinicians, the mean age was 34.6 years (SD=9.1), 76.8% (109) were females and most (76.1%, n=108) had attained post-secondary non-tertiary education level followed by tertiary education (20.4%, n=29). Also, among the non-clinicians, the mean age was 34.3 years (SD=7.0), most (69.1%, n=58) were males, and most (54.8%, n=46) attained tertiary level of education followed by post-secondary no tertiary education (39.3%, n=33).

Descriptive statistics of the raw items/variables

Table 9 presents the descriptive statistics for the raw data for determining implementation fidelity for the TB screening intervention. For example 73% (165) of the providers use the TB screening questionnaire at the HIV clinic during TB screening while 66% do ask all the HIV clients all the TB screening question during screening.

Table 9: Descriptive statistics of the fidelity assessment items among HIV healthcare providers at the HIV clinics in Ghana

Items/Variables	**N=226, n (%)**				
	No			**Yes**	
1. Asks client about cough of any duration.	31 (13.7)			195 (86.3)	
2. Asks if the client has night sweats.	71 (31.4)			155 (68.6)	
3. Asks if the client had fever.	86 (38.1)			140 (61.9)	
4. Asks if the client has pain in the chest.	57 (25.2)			169 (74.8)	
5. Asks/checks if the client lost weight.	74 (32.7)			152 (67.3)	
6. Provides education.	77 (34.1)			149 (56.9)	
7. Provides counselling about TB screening.	62 (27.4)			164 (72.6)	
8. Uses TB screening questionnaire (clinical algorithm).	61 (27.0)			165 (73.0)	
	Never	**Rarely**	**For some clients sometimes**	**Either for all new clients or**	**All the time for all clients**

				annually for existing clients	
9. How frequently do ask PLHIV about cough of any duration during consultation?	31 (13.7)	4 (1.8)	11 (4.9)	10 (4.4)	170 (75.2)
10. How frequently do you ask PLHIV about night sweats during consultation?	71 (31.4)	6 (2.7)	7 (3.1)	5 (2.2)	137 (60.6)
11. How frequently do you ask PLHIV if they had a fever during consultation?	86 (38.1)	5 (2.2)	7 (3.1)	3 (1.3)	125 (55.3)
12. How frequently do you ask PLHIV about pain in the chest during consultation?	57 (25.2)	7 (3.1)	6 (2.7)	5 (2.2)	151 (66.8)
13. How frequently do you ask/check the weight of PLHIV during consultation?	74 (32.7)	6 (2.7)	4(1.8)	5 (2.2)	137 (60.6)
14. How frequently do you provide education for PLHIV?	77 (34.1)	8 (3.5)	15 6.6)	3 (1.3)	123 (54.4)
15. How frequently do you provide counselling about TB screening for PLHIV?	62 (27.4)	5 (2.2)	13 (5.7)	6 (2.7))	140 (62.0)
16. How frequently do you use the TB screening questionnaire for PLHIV?	61 (27.0)	2 (0.9)	22 (9.7)	7 (3.1)	134 (59.3)

Summary statistics note: The total number of interviews with healthcare providers is 226.

Provider implementation fidelity level

The study showed that, providers in 12 out of the 27 HIV clinics scored above the median implementation fidelity score. The results in Table 10 presents the summary statistics of provider fidelity scores for the three components of the intervention and the overall. The study showed that, the TB symptoms questionnaire component had the highest median score of 100% followed by TB diagnosis and TB awareness each scoring 83%.

The overall provider implementation fidelity score ranged from l6% to 100%. The median overall provider implementation score was 79% (IQR: 58.3, 100.0). Out of the 226 HIV care providers, 53% (n=119) had scores above the median fidelity score.

The fidelity scores and levels for the three components were also compared.

Table 10: Summary statistics of the provider fidelity scores by the components

Component of the TB screening intervention	Fidelity score Median (IQR)	High fidelity level n (%)	Low fidelity level n (%)
1. TB Diagnosis	83.33 (50, 100)	126 (55.8)	100 (44.2)
2. TB Awareness	83.33 (50, 100)	120 (53.1)	100 (46.9)
3. TB symptoms questionnaire	100 (16.67, 100)	134 (59.3)	92 (40.7)
Over all	79.17 (58.33, 100)	119 (52.7)	107 (47.3)

TB diagnosis

The fidelity score for the component of TB diagnosis ranged from 17% to 100% with a median score of 83% (IQR: 50, 100). The study showed that about 56% (n=126) of the HIV care providers had an implementation fidelity score above the TB diagnosis median score (high fidelity level). Providers in 16 clinics had a TB diagnosis implementation fidelity score above the median.

TB awareness

The result showed that, the fidelity score for the component of awareness also ranged from 17% to 100%. Its median fidelity score was also 83% (IQR: 50, 100) with about 53% (n=120) of the health care providers scoring implementation fidelity above the median score of awareness component (high fidelity level). Provider in 13 clinics were found to have an awareness component fidelity score above the median.

TB symptoms questionnaire

The level of provider fidelity to implementing the TB screening questionnaire among PLHIV ranged from 17% to 100%, its median score was 100% (IQR: 17%, 100%), and most HIV care providers (59%, n=134) were in high fidelity level category. Similarly, providers in 16 clinics

were found to have an implementation fidelity score above the median for the TB diagnosis component.

Comparison of geographical and provider characteristics between fidelity levels

From the univariate analysis presented in Table 11, most healthcare providers in Brong Ahafo (70%), Western (88%), Greater Accra (60%), Northern (60%), and Volta (87%) regions were not adherent (low IF level) to the intervention guidelines compared to most providers in Ashanti (59%), Central (77%), Upper East (70%), Upper West (77%) and Eastern (55%) regions who implemented the intervention with high fidelity. Providers in Brong Ahafo, Western and Volta regions who were not adherent to the intervention guidelines differ significantly compared to their counterparts who were adherent to the intervention guidelines in same regions. Re-grouped regions into zones as a result of relatively small numbers did not shows statistically significant association between zonal locations and IF level – although providers in Savannah zone were about 1.6 times more likely to implement the intervention with high IF that those in the Forest zone.

Table 11: Comparison of geographical and provider characteristics between fidelity levels

Characteristics of providers	Low fidelity level N (%), M (SD)	High fidelity level N (%), M (SD)	Row Total	crude OR	95%CI
Region					
Ashanti (Ref)	13 (40.6)	19 (59.4)	32	1.00	-
Brong Ahafo	14 (70.0)	6 (30.0)	20	0.29*	0.09 – 0.96
Central	7 (22.6)	24 (77.4)	31	2.35	0.78 – 7.04
Eastern	19 (45.2)	23 (54.8)	42	0.83	0.33 – 2.10
Greater Accra	12 (60.0)	8 (40.0)	20	0.46	0.14 – 1.43
Northern	9 (60.0)	6 (40.0)	15	0.46	0.13 – 1.59
Upper East	6 (30.0)	14 (70.0)	20	1.60	0.49 – 5.24
Upper West	3 (23.1)	10 (76.9)	13	2.28	0.52 – 9.92
Volta	7 (87.5)	1 (12.5)	8	0.10*	0.01 – 0.89
Western	17 (68.0)	8 (32.0)	25	0.32*	0.11 – 0.96

Ecological zone					
Forest *(Brong Ahafo, Ashanti & Eastern)* (Ref)	46 (48.9)	48 (51.1)	94	1.00	-
Savannah *(Upper East, Upper West & Northern*)	18 (37.5)	30 (62.5)	48	1.60	0.78 – 3.25
Coastal *(Gt. Accra, Western, Central & Volta)*	43 (51.2)	41 (48.8)	84	0.91	0.51 – 1.65
Mean age of provider in completed years	33.8 (6.9)	35.1 (9.4)	-	1.02	0.98 – 1.05
Years working in HIV clinic					
<5years (Ref)	72 (49.0)	75 (51.0)	147	1.00	-
5years plus	35 (44.3)	44 (55.7)	79	1.20	0.70 – 2.09
Gender					
Male (Ref)	55 (60.4)	36 (39.6)	91	1.00	-
Female	52 (38.5)	83 (61.5)	135	2.44*	1.41 – 4.20
Profession					
Non-clinician (Ref)	50 (59.5)	34 (40.5)	84	1.00	-
Clinician	57 (40.1)	85 (59.9)	142	2.19*	1.27 – 3.80
Highest educational level					
Upper secondary (Ref)	7 (70.0)	3 (30.0)	10	1.00	-
Post-secondary non-tertiary	65 (46.1)	76 (53.9)	141	2.73*	1.08 – 10.98
Tertiary	35 (46.7)	40 (53.3)	75	2.67	0.64 – 11.10

Note: The totals are in row and therefore correspond to total percentages of 100%.

**Significant at 95%CI*

Provider IF levels significantly ($p<0.05$) varied in terms of gender, profession, level of education attained (tertiary level) of the healthcare provider. The results show 61% of female providers had a high level of adherence to the TB screening intervention guidelines, as did 60% of clinician providers, 40% of non-clinician providers, 54% of healthcare providers who attained postsecondary non-tertiary education, and 53% of providers with tertiary education. Female providers were about 2.4 times more likely to adhere to implementation guidelines than male counterparts ($p<0.05$). Also, providers who attained post-secondary non-tertiary were about 3 times more likely to implement the intervention with high IF than those who attained upper secondary ($p<0.05$). The study found no significant difference in provider IF levels across educational age and the number of years working at the HIV clinic ($p>0.05$).

Factors associated with provider implementation fidelity level

We used the ecological zones in the multiple logistic regression instead of regions due to the small sample sizes and their potential effects on the confidence intervals. The cluster-based logistics regression result after adjusting for the district hospital as the cluster effect showed that gender, profession, and tertiary educational level of the HIV care provider were significantly associated with provider IF level (Table 12). After adjusting for other factors and the hospital effect, female providers were about 2.4 times (AOR=2.36, 95% CI: 1.09 – 5.10, p=0.029) more likely than their male counterparts to implement the TB screening intervention among PLHIV with high IF level.

Table 12: Multivariable logistic regression between implementation fidelity level and background factors with district hospital (random) effect

Characteristics of providers	**AOR**	**95% CI**	**p-value**
Ecological zonal			
Forest *(Brong Ahafo, Ashanti & Eastern)* (Ref)	1.00	-	-
Savannah *(Upper East, Upper West & Northern*)	1.83	0.70 – 4.80	0.220
Coastal *(Gt. Accra, Western, Central & Volta)*	0.95	0.28 – 3.21	0.942
Gender			
Male (Ref)	1.00	-	
Female	2.36	1.09 – 5.10	0.029**
Profession			
Non-clinician (Ref)	1.00	-	-
Clinician	1.78	1.07 – 3.50	0.045*
Highest educational level			
Upper secondary (Ref)	1.00	-	-
Post-secondary non-tertiary	2.66	0.48– 14.66	0.260
Tertiary	4.31	2.12 – 9.10	0.040**

AOR=adjusted odds ratio, * marginal significant and ** significant at 95%CI

The odds of being a clinician (AOR=1.78, 95%CI: 1.07 – 3.50, p=0.045), and attaining tertiary education level (AOR=4.31, 95%CI: 2.12 – 9.10, p=0.040) and implementing the intervention with high compliance is higher than being a non-clinician, and attaining upper secondary educational level after adjusting for other factors and hospital effect.

4.5 Discussion

This study aimed to assess provider IF to the guideline on TB screening among PLHIV attending HIV clinics in Ghana and potential factors associated with IF level. Despite the growing number of studies assessing fidelity of implementation in health, our study is the first in Ghana and one of the few in Africa to assess implementation outcome such as fidelity to the guideline on TB screening at the HIV clinics. Most studies conducted in this area focused on intervention outcomes such as cured, died, completed treatment**,** among others [42,54]. The determination of IF scores were done the summation approach based on providers' responses to questions on core components of the intervention [55]. The IF level refers to those providers with composite scores equal or above the median score (high IF level) vs. those with composite scores below the median score (low IF level). This approach advances methods for measuring IF by statistically defining what constitutes high versus low level of fidelity. The creation of a level of implementation (low versus high implementation) is one of the two ways of assessing fidelity [15,56], that is rarely applied in the IS literature

Based on the structured questionnaires, the first key finding of this study is that, among all healthcare providers surveyed, 53% had scores equal or above the overall median fidelity score of 79%. Since there was no existing reference point of what constitutes high implementation fidelity level, using the median as a cut-off as done in our study implies that only 53% of the providers implemented the intervention with a higher level of fidelity than the 79%. The number who implemented with high fidelity was marginally (6% points) higher than those who implemented with lower fidelity score than the median. It is difficult to interpret whether a 79% fidelity score is adequate, for the TB screening intervention, in this context. This fairly high percentage of providers with lower adherence score (<79%) might lead to spurious conclusions about the effectiveness of the intervention [17,57,58]. Putting this finding in context, there is evidence that coverage of the intervention has been below set targets in the past years [51]. Our

findings show that, overall, 47% of providers implement the intervention with low fidelity which may contribute to this sub-optimal coverage. We observed high provider fidelity scores in only 12 out of the 27 HIV clinics. Among the three components, providers in 16 clinics adhered to the items or activities constituting the TB diagnosis and the TB symptom questionnaire components**.**

Provider non-adherence or low IF of healthcare interventions are known in the published literature to weaken chances of attaining intervention outcomes and render efficacious interventions ineffective in real life [22].

The next key finding of our study is that contextual factors (geographical location) influence the level of IF to the intervention. Even though a moderate proportion of healthcare providers implemented TB screening among PLHIV with high fidelity level overall, there were marked statistically significant differences in the level of fidelity of implementation across some regions. Among the 10 regions of the country at the time of the study, most healthcare providers in five regions adhered (55-77%) to the intervention guidelines whilst in the other five regions, most did not (60-88%). The urbanity of the facility where the intervention is being implemented influences IF level [13,59,60]. Even though our study found some relationship between the regional locations of the district hospital and IF level, it is beyond the scope of this study to delve into urbanity of the district hospitals where this study was conducted. Although the samples sizes were small, regional location is a critical factor in our analysis because the health system of Ghana has cascading administrative management from regional through the district to hospital level and implementation of new intervention are discussed and planed using the top-bottom approach. Hospitals within the same region should share similar findings from an intervention. It will be worthwhile to investigate more fully the impact of context in the implementation of this intervention. Regions were re-grouped into three ecological zones (forest, savannah and coastal) due to insufficient sample size as mentioned. After accounting for the HIV clinic as a cluster effect, none of the ecological locations of the HIV clinic was found to statistically influence the IF level. That notwithstanding, since the TB screening intervention is guided by universal national protocols and guidelines it is expected that the adherence to intervention guidelines by providers will be uniform spatially. But our study found variability in IF spatially which is similar to the variability found between primary healthcare facilities in South Africa [30]. It is therefore important that supporting activities and

resources aimed at ensuring provider adherence with TB screening should be streamlined across all regions to ensure uniformity in the delivery of the intervention.

Our study found that provider characteristics influenced IF level, similar to other studies in the literature [11,12,15,56]. Factors reported in the literature to influence the level of fidelity include gender, education, cadre (profession), perceived need and benefit of the intervention, and work experience [15,24]. Regarding factors that influence level of fidelity, we assessed the demographic aspect of the provider characteristics. Our findings from the cluster-based logistic regression analysis showed that the gender, profession, educational level of the providers were statistically significantly associated with provider IF to TB screening among PLHIV. This study found that after adjusting for the cluster effect (district hospital (HIV clinic)), female providers and clinicians adhered mostly to the implementation guideline and those with higher education also complied most to the intervention guidelines. We expected provider experience to influence IF but our study did not find such an association, though another study found that experience in terms of the number of years worked at the HIV clinic may not influence IF [60]. They argued that though providers experience is worth considering for implementation, in their study experience could not have predicted fidelity of implementation because most, if not all, healthcare providers had adequate levels of education and experience [60].

Strengths and limitation

To our knowledge, this study is one of the first that assess provider implementation fidelity to the TB screening intervention in sub-Sahara Africa particularly in the context of Ghana. This study thus assessed implementation outcome, whereas most studies assess the effectiveness of the intervention in terms of the intervention outcomes. This study was a census-based survey of all HIV care providers at all the study sites which allowed us to make a good conclusion. In an attempt to reduce and combine data, we attempted a robust analytical approach through a factor analytic technique to determine factors underlying assessment of IF of the intervention. This approach did not add any value to the analysis. We therefore resorted to using original items to assess fidelity. Finally, modified CFIF directed the assessment of contextual and demographics factors found to relate to IF. The VIF showed that multicollinearity was not an issue of concerned in the logistic model

The study also had some limitations. It assessed implementation fidelity using provider self-reported responses on how TB screening intervention among PLHIV is being implemented. Like all other studies of this nature, there is a major limitation with regards to the validity and accuracy of self-reported responses due to possible social desirability and recall bias [56,61–63]. However, since providers interviewed were all active and currently delivering the intervention, issues with recall errors were highly minimized. Also, this method offers a time and cost-efficient means to obtain clinical and program level information from the provider perspective compared to methods that involve independent observations [22]. We had a challenge with the categorization of fidelity levels because there are no existing norms or references. We, therefore, chose the median as the cut-off because our data was not normally distributed. Median as a cut-off might lead to loss of information and reducing the statistical power to detect a relation between the variables and fidelity level, hence some of the findings should be interpreted with caution. Notwithstanding, the median serves as a yardstick and lesson learned can inform better implementation of the intervention in this and other settings. Also, categorizing fidelity into high or low simplified the statistical analysis which led to easy interpretation and presentation of our result.

4.6 Conclusion

IF studies are important yet there are no existing norms for its categorization. This study added to knowledge another way of determining IF levels and information needed to meaningfully conclude on the performance of the TB screening intervention implemented over a decade in Ghana.

The study suggests that a high level of IF to the intervention was marginally achieved, i.e. a little above the median fidelity score for each of the three components as well as the overall. We, therefore, found elements of healthcare provider adherence as well as some evidence of low IF among healthcare providers delivering TB screening intervention to PLHIV. Some researchers have referred to these bottlenecks in implementation fidelity as type III errors [58,64] and argue that such errors can negatively affect intervention effectiveness. Nevertheless, regional location, gender, profession, and level of education were associated significantly with IF levels in this study.

Supporting strategies such as continuous training, coaching and program review among providers and program managers should be at the core of program implementation in this context. Strategies for monitoring and measuring implementation fidelity should be clearly defined and implemented to offer constant program performance information to serve as the basis for recommendations to improve program implementation outcomes.

In summary, our study demonstrated a systematic way of assessing fidelity of implementation at the provider level using the core components of the intervention. IF assessment should be encouraged or incorporated into government or national interventions to understand the weakness and areas of the intervention that needs improvement to be able to keep to desire outcomes of interventions. Most fidelity assessments were done as such but implementation scientists should consider assessing fidelity at the health facility level. This is where resources and guidelines are discussed and discharged to providers. Finally, since the providers did not fully adhere to three components of the intervention, it indicates an opportunity for improvement of the current implementation of the TB screening intervention among PLHIV attending HIV clinics.

Reference

1. Date A, Modi S. TB Screening Among People Living With HIV/AIDS in ResourceLimited Settings. JAIDS J Acquir Immune Defic Syndr. 2015 Apr 15;68:S270–3.
2. Getahun H, Van Gorkom J, Harries A, Harrington M, Nunn P, Perriens J, et al. Interim Policy on Collaborative TB/HIV Activities. TB/HIV Research Foundation Regional Office for Africa South Africa). Paul Nunn Paul Pronyk; 2004.
3. WHO. WHO policy on collaborative TB/HIV activities Guidelines for national programmes and other stakeholders. 2012.
4. Gupta S, Granich R, Date A, Lepere P, Hersh B, Gouws E, et al. Review of policy and status of implementation of collaborative HIV-TB activities in 23 high-burden countries. Int J Tuberc Lung Dis. 2014 Oct 1;18(10):1149–58.
5. Getahun H, Gunneberg C, Granich R, Nunn P. HIV Infection–Associated Tuberculosis: The Epidemiology and the Response. Clin Infect Dis. 2010 May 15;50(s3):S201–7.

6. Ghana Health Service. Implementation of TB / HIV collaborative activities in Ghana: Technical policy and guidelines. 2007.
7. Ghana Health Service. Implementation of TB/HIV collaborative activities in Ghana: Joint programme planning policy and guidelines. 2014.
8. Abebe R, Fantahun M, Hailemicheal Y, Yizengaw M, Zegeye MM. Hiv testing and counseling among patients with tuberculosis at arbaminch hospital, Southern Ethiopia. Am J Trop Med Hyg. 2013;89(5):232.
9. World Health Organisation. Tuberculosis country profiles (Ghana). 2020.
10. World Health Organization W. GLOBAL TUBERCULOSIS REPORT 2020. 2020.
11. Hasson H. Systematic evaluation of implementation fidelity of complex interventions in health and social care. Implement Sci. 2010 Sep 3;5(1):67.
12. Hasson H, Blomberg S, Dunér A. Fidelity and moderating factors in complex interventions: a case study of a continuum of care program for frail elderly people in health and social care. Implement Sci. 2012 Mar 22;7(1):23.
13. Nurjono M, Shrestha P, Ang IYH, Shiraz F, Yoong JSY, Toh SAES, et al. Implementation fidelity of a strategy to integrate service delivery: learnings from a transitional care program for individuals with complex needs in Singapore. BMC Health Serv Res. 2019 Mar 19;19(1):177.
14. Nilsen P, Bernhardsson S. Context matters in implementation science: A scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. Vol. 19, BMC Health Services Research. BioMed Central Ltd.; 2019. p. 189.
15. Durlak JA, DuPre EP. Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. Am J Community Psychol. 2008 Jun;41(3–4):327–50.
16. Eboreime EA, Eyles J, Nxumalo N, Eboreime OL, Ramaswamy R. Implementation process and quality of a primary health care system improvement initiative in a decentralized context: A retrospective appraisal using the quality implementation framework. Int J Health Plann Manage. 2019 Jan 1;34(1):e369–86.
17. Department of Health and Human Services. USA. The Importance of Quality Implementation For Research. 2013;(February).
18. Durlak JA. The importance of implementation for research, practice, and policy. Child Trends. 2011;34:1–10.

19. Dusenbury L, Brannigan R, Hansen WB, Walsh J, Falco M, Ghana NACP, et al. Quality of implementation: developing measures crucial to understanding the diffusion of preventive interventions. Who. 2014 Jun 1;15(1):1–9.
20. Roberts G (Gregory J., Vaughn S, Beretvas SN, Wong V. Treatment fidelity in studies of educational intervention. Routledge; 2017.
21. Mihalic S. The Importance of Implementation Fidelity. 2002.
22. Breitenstein SM, Gross D, Garvey CA, Hill C, Fogg L, Resnick B. Implementation fidelity in community-based interventions. Res Nurs Health. 2010 Apr;33(2):164–73.
23. Mowbray CT, Holter MC, Teague GB, Bybee D. Fidelity criteria: Development, measurement, and validation. Am J Eval. 2003 Sep 30;24(3):315–40.
24. Carroll C, Patterson M, Wood S, Booth A, Rick J, Balain S. A conceptual framework for implementation fidelity. Implement Sci. 2007 Dec;2(1):1–9.
25. Flottorp SA, Oxman AD, Krause J, Musila NR, Wensing M, Godycki-Cwirko M, et al. A checklist for identifying determinants of practice: A systematic review and synthesis of frameworks and taxonomies of factors that prevent or enable improvements in healthcare professional practice. Vol. 8, Implementation Science. 2013.
26. VanDevanter N, Kumar P, Nguyen N, Nguyen L, Nguyen T, Stillman F, et al. Application of the Consolidated Framework for Implementation Research to assess factors that may influence implementation of tobacco use treatment guidelines in the Viet Nam public health care delivery system. Implement Sci. 2017 Dec 28;12(1):27.
27. Mihalic, Sharon F.; Muller J. Blueprints, a Violence Prevention Initiative - Google Books.
28. Hulleman, Chris S; Rimm-Kaufman, Sara E; Abry T. Innovative methodologies to explore implementation: Whole-part-whole—Construct validity, measurement, and analytical issues for intervention fidelity. In T. Halle, A. Metz, & I. Martinez-Beck (Eds.), Applying implementation science in early childhood prog. APA. 2013;
29. Brown TA. Confirmatory Factor Analysis for Applied Research.
30. Lebina L, Alaba O, Ringane A, Hlongwane K, Pule P, Oni T, et al. Process evaluation of implementation fidelity of the integrated chronic disease management model in two districts, South Africa. BMC Health Serv Res. 2019 Dec 16;19(1):1–14.
31. Cochrane LJ, Olson CA, Murray S, Dupuis M, Tooman T, Hayes S. Gaps between knowing and doing: Understanding and assessing the barriers to optimal health care. J Contin Educ Health Prof. 2007 Mar;27(2):94–102.

32. Lönnroth K, Corbett E, Golub J, Godfrey-Faussett P, Uplekar M, Weil D, et al. Systematic screening for active tuberculosis: Rationale, definitions and key considerations. Vol. 17, International Journal of Tuberculosis and Lung Disease. 2013. p. 289–98.
33. Peters DH, Tran NT, Adam T. Implementation Research in Health: A Practical Guide. Who. 2013;69.
34. Roberts, Greg; Vaughn, Sharon; Beretvas, S Natasha; Wong V. (PDF) Measuring Fidelity in Educational Settings. Routledge; 2017. 1–150 p.
35. Naleppa MJ, Cagle JG. Treatment Fidelity in Social Work Intervention Research: A Review of Published Studies.
36. Durak U, Schmidt A, Pawletta T. Model-Based Testing for Objective Fidelity Evaluation of Engineering and Research Flight Simulators. In American Institute of Aeronautics and Astronautics (AIAA); 2015.
37. Albert A, Hallowell MR, Kleiner B, Chen A, Golparvar-Fard M. Enhancing construction hazard recognition with high-fidelity augmented virtuality. J Constr Eng Manag. 2014 Jul 1;140(7).
38. Kok MSY, Jones M, Solomon-Moore E, Smith JR. Implementation fidelity of a voluntary sector-led diabetes education programme. Health Educ. 2018;118(1):62–81.
39. Schmidt B, Watt K, McDermott R, Mills J. Assessing the link between implementation fidelity and health outcomes for a trial of intensive case management by community health workers: A mixed methods study protocol. BMC Health Serv Res. 2017 Jul;17(1):490.
40. Ahorlu CK, Bonsu F. Factors affecting TB case detection and treatment in the Sissala East
District, Ghana. J Tuberc Res. 2013;01(03):29–36.
41. Addo KK, Ampofo WK, Owusu R, Bonsu C, Nartey N, Mensah GI, et al. First Nationwide Survey of the Prevalence of TB/HIV Co-Infection in Ghana. J Tuberc Res. 2018 May 9;06(02):135–47.
42. Ansa GA, Sifa JS. Tuberculosis and HIV integration in sub-Saharan Africa. Asian Pacific J Trop Dis. 2015;5(11):841–9.
43. Ansa GA, Walley JD, Siddiqi K, Wei X. Assessing the impact of TB/HIV services integration on TB treatment outcomes and their relevance in TB/HIV monitoring in Ghana. Infect Dis Poverty. 2012;1(1):1.

44. Sidani S. Fidelity of Intervention Implementation: A Review of Instruments. Health (Irvine Calif). 1980;7:1687–95.
45. Breitenstein SM, Fogg L, Garvey C, Hill C, Resnick B, Gross D. Measuring Implementation Fidelity in a Community-Based Parenting Intervention. Nurs Res. 2010 May;59(3):158–65.
46. Clark A, Breitenstein S, Martsolf DS, Winstanley EL. Assessing Fidelity of a CommunityBased Opioid Overdose Prevention Program: Modification of the Fidelity Checklist. J Nurs Scholarsh. 2016 Jul;48(4):371–7.
47. Hernandez M, Gomez A, Lipien L, Greenbaum PE, Armstrong KH, Gonzalez P. Use of the System-of-Care Practice Review in the National Evaluation. J Emot Behav Disord. 2001 Jan 14;9(1):43–52.
48. Elbeck M. An approach to client satisfaction measurement as an attribute of health service quality. Health Care Manage Rev. 12(3):47–52.
49. Steiber SR. Preventing pitfalls in patient surveys. Health Care Strateg Manage. 1989 May 1;7(5):13–6.
50. Blodgett JG, Hill DJ, Tax SS. The effects of distributive, procedural, and interactional justice on post complaint behavior. J Retail. 1997 Jun 1;73(2):185–210.
51. Ghana Health Service. Implementation of TB/HIV Collaborative Activities in Ghana : Joint Programme Planning Policy and Guidelines Implementation of TB/HIV Collaborative Activities in Ghana Joint Programme Planning Policy and Guidelines. Accra; 2014.
52. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ. 2011 Jun 27;2:53–5.
53. StataCorp. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC. 2017.
54. Osei E, Der J, Owusu R, Kofie P, Axame WK. The burden of HIV on Tuberculosis patients in the Volta region of Ghana from 2012 to 2015: Implication for Tuberculosis control. BMC Infect Dis. 2017;17(1):1–9.
55. Abry T, Hulleman CS, Rimm-Kaufman SE. Using Indices of Fidelity to Intervention Core Components to Identify Program Active Ingredients. Am J Eval. 2015 Sep 6;36(3):320–38.
56. James Bell A. Evaluation Brief: Measuring Implementation Fidelity. James Bell Assoc. 2009;(October):1–6.

57. Lewis CC, Fischer S, Weiner BJ, Stanick C, Kim M, Martinez RG. Outcomes for implementation science: an enhanced systematic review of instruments using evidencebased rating criteria. Implement Sci. 2015 Dec 4;10(1):155.
58. Sánchez V, Steckler A, Nitirat P, Hallfors D, Cho H, Brodish P. Fidelity of implementation in a treatment effectiveness trial of Reconnecting Youth.
59. Crosse S, Williams B, Hagen CA, Harmon M, Ristow L, DiGaetano R, et al. Prevalence and Implementation Fidelity of Research-Based Prevention Programs in Public Schools: Final Report.
60. Bonnie Klimes-Dougan, Gerald J. August, Chih-Yuan Steven Lee, George M. Realmuto, Michael L. Bloomquist, Jason L. Horowitz and TLE. Practitioner and site characteristics that relate to fidelity of implementation: The Early Risers prevention program in a goingto-scale intervention trial. Prefessional Psychol Res Pract. 2009;40(No. 5):467–75.
61. Breitenstein SM, Gross D, Garvey CA, Hill C, Fogg L, Resnick B. Implementation fidelity in community-based interventions. Res Nurs Heal. 2010 Apr;33(2):164–73.
62. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice : a consolidated framework for advancing implementation science. 2009;15:1–15.
63. Ennett ST, Haws S, Ringwalt CL, Vincus AA, Hanley S, Bowling JM, et al. Evidencebased practice in school substance use prevention: fidelity of implementation under realworld conditions. Health Educ Res. 2011 Apr;26(2):361–71.
64. Dobson KS, Singer AR. Definitional and Practical Issues in the Assessment of Treatment Integrity. Clin Psychol Sci Pract. 2006 May 11;12(4):384–7.

5.0 Facility-/Programme-level Implementation Fidelity to TB Screening Guidelines

Chapter five presents paper 2 (original paper attached as appendix B) which entails objectives 3 and 4 of the study. This result chapter includes an introduction, methods, results and discussion sections with the list of references cited in the paper. It describes the extent of adherence to the implementation guidelines by the facility. Also, it describes the facility level factors which influenced facility-level fidelity to the implementation guidelines of the intervention.

5.1 Abstract

Background: Tuberculosis screening of people living with HIV (PLHIV) – an intervention to reduce the burden of TB among PLHIV – is being implemented at HIV clinics in Ghana since 2007, but TB screening coverage remains low. Facility adherence to intervention guidelines may be a factor but is missing in implementation science literature. This study assesses the level of HIV clinic adherence to the guidelines and related facility characteristics in selected district hospitals in Ghana.

Methods: This cross-sectional study was conducted in all 27 district hospitals with HIV clinics, X-ray and geneXpert machines in Ghana. These hospitals are in 27 districts representing about 27% of the 100 district hospitals with HIV clinics in Ghana. A data collection tool with 18-items (maximum score of 29) was developed from the TB/HIV collaborative guidelines to assess facility adherence to four interrelated components of the TB screening programme as stated in the guidelines: intensive TB case-finding among PLHIV (ITCF), Isoniazid preventive therapy initiation (IPT), TB infection control (TIC), and programme review meetings (PRM). Data were collected through record review and interviews with 27 key informants from each hospital. Adherence scores per component were summed to determine an overall adherence score per facility and summarized using medians and converted to proportions. Facility characteristics were assessed and compared across facilities with high (above median) versus low (below median) overall adherence scores, using nonparametric test statistics.

Results: From the 27 key interviews and facility records reviewed, the median adherence scores for ITCF, IPT, TIC, and PRM components were 85.7% (IQR: 85.5-100.0), 0% (IQR: 0-

66.7), 33.3% (IQR: 33.3-50.0), and 90.0% (IQR: 70.0-90.0), respectively. The overall median adherence score was 62.1% (IQR: 58.6-65.1), and 17 clinics (63%) with overall adherence score above the median were categorized as high adherence. Compared to low adherence facilities, high adherence facilities had statistically significant lower PLHIV clinic attendees per month (256 (IQR: 60-904) vs. 900 (IQR: 609-2622); p=0.042), and lower HIV provider workloads (28.6 (IQR: 8.6-113) vs. 90 (IQR: 66.7-263.5); p=0.046), and most had screening guidelines (76%, p<0.01) and questionnaire (80%, p<0.01) available on-site.

Conclusion: PRM had highest score while the IPT component had the lowest score. Almost a third of the facilities implemented the TB screening programme activities with a high level of adherence to the guidelines. We suggest to ensure adherence to all four components, reducing staff workloads and making TB screening questionnaires and guidelines available on-site would increase facility adherence to the intervention and ultimately achieve intervention targets.

Keywords: Programme adherence, facility characteristics, TB screening, PLHIV, HIV clinics, Implementation research, Ghana

5.2 Introduction

Tuberculosis (TB) is a significant public health problem of global concern [1,2]. Though curable, it is a significant contributor to deaths among people living with HIV (PLHIV) [3]. Due to their immune-compromised systems, PLHIV are 20-30 times more likely to contract active TB than non-HIV infected people [4,5]. Among PLHIV with TB, the lifetime risk of dying is 50% compared to 5–10% in non-HIV infected people with TB [6–8].

To reduce the dual burden of TB and HIV in the population, the World Health Organization (WHO) instituted policy guidelines on TB/HIV collaborative activities in service delivery [4,5]. These WHO policy guidelines [4] recommend the use of a simplified TB screening questionnaire that asks PLHIV about the absence or presence of four clinical TB symptoms (current cough, weight loss, fever and night sweats) in order to identify screen-negative people and initiate them on Isoniazid preventive therapy (IPT) as prophylactic treatment [4,9,10]. The screening is to be done at the initial diagnosis or presentation of HIV and every subsequent

visit for HIV care [11]. Many countries where the burden of TB/HIV co-infection is high, including Ghana, are implementing TB screening of PLHIV amongst other TB/HIV collaborative interventions [12].

The estimated prevalence of TB in Ghana in 2017 was 152 per 100,000 population, and 27% of TB patients were co-infected with HIV [13]. Ghana started implementing the TB screening among PLHIV in 2007 as a control measure. In 2014 the policy and guidelines for the implementation of TB/HIV collaborative activities in Ghana were revised to provide a detailed way for enhancing the collaboration between the Ghana National Tuberculosis Control Programme (NTP) and the National AIDS/STI Control Programme (NACP) [5]. The revised document [5] outlined responsibilities for all levels of delivery in TB/HIV collaboration, including the health facility and healthcare provider level. With the aim of reducing TB burden among PLHIV, the revised policy set out targets for TB screening coverage (56%, 64%, 70%, 80%, 85% and 90% in 2015 to 2020 respectively) among PLHIV in HIV care or treatment settings [5,14]. The TB screening intervention as per the NTP is ongoing at all district hospitals (DHs) with a functioning HIV clinic, as set out in the detailed policy and guidelines [5].

Evidence from the literature [7,9,15,16] shows that TB screening among PLHIV is a critical and necessary step to implementing Isoniazid preventive therapy (IPT) initiation, towards reducing the burden of TB in PLHIV. However, the expected outcome of the intervention has not been fully achieved in Ghana since its implementation. For instance, about 80% and 41% of PLHIV attending clinics in Ghana were not screened for TB in 2013 and 2014 respectively [5,17] (this was part of the reason for the 2014 TB/HIV policy review) and 47.9% in 2019 [18]. What is not clear is why this intervention of proven effectiveness [19] is not producing the expected result in Ghana. Implementation effectiveness is determined by measuring implementation outcomes such as implementation fidelity [20], sometimes referred to as adherence, which is defined as implementing an intervention according to programme design or guideline [21].

Health programs often provide implementation guidelines for *(1)* the organization/facility (facility levelguidelines to which health facilities or other implementing units should adhere), and *(2)* healthcare providers to apply (clinical guidelines) [4,5,22–24]. The extent of adherence to TB screening among PLHIV at the organizational or facility level is an essential discussion missing in the implementation science literature. Furthermore, research shows that factors such as *organizational structure*, *staffing availability*, *physical facilities and resources*, and

geographical location influence adherence to health programs [25–28], no research is available on the extent to which health facilities in Ghana adhere to the programme guideline on TB screening of PLHIV.

This study's aim was to investigate programme fidelity or the level of adherence by district hospital HIV clinics in Ghana to the guidelines on the delivery of TB screening amongst PLHIV. In the context of our study, programme adherence refers to the degree to which the DHs deliver the TB screening of PLHIV intervention according to the Ghana NTP guideline. However, the extent to which DHs in Ghana adhere to these programme guideline components has not been assessed. We expected that the level of adherence by the health facilities to the guidelines would vary across facility characteristics. Therefore our secondary aim was to examine the significant differences in facility characteristics between facilities with high adherence and low adherence level. We anticipate the result can inform the designers of the NTP and the TB screening programme at the facility level on areas for improvement in the implementation process.

5.3 Methods

Study setting

Ghana is administratively divided into 216 districts across 10 regions [29]. These regions are further grouped into three ecological zones (Savannah, Forest and Coastal zones) based on their economic activities and ecology. The health system is divided along the existing administrative regions and districts [30], with decentralized health management teams at the district level. The DHs serve as the first point of referrals from the peripheral health facilities and provide both outpatient and in-patient services. Each DH provides services to a population of 100,000 to 200,000 people with between 50 to 60 available beds. Each district is expected to have a DH, but as of 2017, there were 144 DHs across the country [30], 100 of which had an HIV clinic or treatment setting, and delivered the TB screening intervention targeting PLHIV attending the HIV clinic [5].

A team of health professionals led by the head of the district hospital **(m**edical doctor) facilitates the delivery of the TB/HIV collaborative activities at the district hospital level. The

head of the facility is the point of call for undertaking any health-facility based intervention. Other key team members include the facility TB/HIV coordinator (disease control officer or nurse) appointed to be responsible for running the day-to-day implementation and oversight of the TB/HIV collaborative activities and head of the HIV clinic (medical assistant) who manages staff and activities at the clinic.

The NTP guideline outlines the activities required at all the HIV clinics for the delivery of TB screening of PLHIV [5,14]. These activities include ensuring the availability of an HIV clinic, providing services for routine TB screening for PLHIV, providing TB confirmatory procedures through sputum testing or chest x-ray, ensuring TB infection and control activities, and conducting regular meetings on TB case finding with HIV care providers for feedback [4,5]**.** The use of IPT in all PLHIV was not a national policy in Ghana; however, it is supported in HIV specialized cases and children under 5 years where patients are supervised to go through and complete treatment [5]. In 2017, the Ghana NTP earmarked 27 of the 100 DHs with HIV care or treatment services to implement the initiation of IPT for all PLHIV who screened negative on TB screening [31]. According to the IPT implementation plan by the Ghana Health Service, the 27 facilities were selected because they were ART sites with both digital x-ray machines and GeneXpert at the time of implementation. The justification was that it is easier to monitor them as initial roll-out sites because they had molecular diagnostic equipment such the digital x-ray and GeneXpert machines needed to rule out active TB before initiating the IPT. This study was therefore conducted in these 27 DHs representing 27% of the 100 DHs with HIV clinics in Ghana.

Study design

This was a cross-sectional and census-based study which is part of a more extensive study that assessed the implementation fidelity and determinants of TB screening and IPT initiation among HIV clients attending HIV clinics in Ghana. Every evidence-based intervention has critical components [32–34], and how well these components are implemented determines the effectiveness or success of the intervention [35]. According to Carroll et al.'s conceptualization of fidelity [21], adherence is defined in terms of four constructs – content (implementing the required intervention content), frequency, duration and coverage.

To investigate the level of adherence by the DHs to the intervention guideline, we adapted the Conceptual Framework for Implementation Fidelity proposed by Carroll [21]. Three of Carroll's four constructs – content, frequency and coverage of the intervention [21] – were thought applicable and relevant to this study.

Components of the intervention

Intervention implementation in a health facility follows a "top-down" approach (facility level to the provider level) [36]; adherence at the facility level ("top") influences the degree to which an intervention is implemented [21] at the provider level ("bottom").

From the content of the NTP guidelines (which also align with WHO's recommendation), we identified four components of the intervention as follows:

1. *Intensive TB case-finding among PLHIV (ITCF)* through the HIV clinic by screening all PLHIV attending HIV clinic for TB, conducting TB evaluation and the extent to which there was regular or routine delivery of these activities as required by the guidelines;
2. *IPT initiation (IPT)* in specialized cases recommended by clinicians. These include children under 5 years who are exposed to people with active TB and persons with immunosuppression as a result of chemotherapy, prolonged steroid use and persons on renal replacement therapy [5];
3. *TB infection control (TIC)* to prevent the spread and increase of TB in the facility through activities such as having TB infection control plan, a mandatory examination of all health workers for TB and administrative, environmental and personal protection control; and
4. *Programme review meeting (PRM)* to be conducted monthly to involve all the HIV clinic staff discussing issues with quality data sharing and feedback.

These components and their activities were designed to align with NTP guidelines. The four major components identified from the guideline comprised some activities that when implemented, the aim of the intervention will be realized.

Study sample

All the 27 DHs that had been earmarked by the NTP to be the first facilities providing IPT initiation for PLHIV were included in this study. The NTP listed those 27 facilities to implement the integrated TB/HIV intervention (IPT initiation) based on the fact that they have functioning HIV clinics and have both digital X-ray and GeneXpert testing capacity to rule out TB disease [37].

For this study, the intent was to interview the 27 DHs heads, but where the head was unavailable, we interviewed the facility TB/HIV coordinator or the head of the HIV clinic instead. The TB registers were reviewed and data extracted for the year 2018. The assessment of fidelity in this study was from the perspective of the hospital managers.

Data collection and measurement

Data collection was from 9^{th} –24^{th} April 2019 by a team of 12 field officers. Using the intervention components identified, we developed an adherence assessment tool because none existed. The tool which was partly questionnaire and partly data extraction form was designed to score the extent to which the DHs adhered to the guidelines – i.e. whether they undertook the prescribed activities of the four components (ITCF, IPT, TIC, and PRM). These activities were therefore used as variables on the tool. Data were collected in two stages on weekdays. The first stage was a face-to-face interview through the administration of a semi-structured questionnaire to the head of the DH or appointed representative. The questionnaire was structured to collect data on the sociodemographic (age sex, cadre, etc.) of the respondent, TB screening activities provided by the facility, and availability of resources (staff, TB screening questionnaire, TB/HIV clinical manual, etc.). The second stage involved using a predesigned data extraction form to extract from the TB and HIV clinic care registers monthly aggregated TB patient data for the period of 1 January to 31 December 2018. Data on number of new and existing HIV patients, number screened for TB, number presumed TB, number confirmed and number initiated on IPT were extracted. (See Additional file1.docx which is a table (Table S1) providing detail information on the elements in the data extraction form and the questionnaire).

Where any of these data were missing, the health information officer in charge at the HIV clinic was consulted for rectification. Unresolved missing records were classified incomplete and therefore excluded; 2 records were excluded. All the data collection tools were pre-tested in two similar facilities to minimize measurement errors and identify problem areas for rectification. Three interviews were conducted in each facility (Heads of facility, HIV clinic and facility TB/HIV coordinator) and monthly data for 12 months was extracted for each facility.

To measure programme adherence, the four critical components of the intervention (as described above) were identified and the study collected data to measure the facility adherence to each of these components (activities). Adherence was scored per activity. The guidelines detailed how these activities should be implemented. Therefore, we scored the activity as adherent/not adherent if the recommended activity was implemented/not implemented accordingly [38]. Table 13 presents the four components of the intervention for TB screening among PLHIV, the items (activities) and score per component, and the source of information.

Table 13: TB screening activities and scores by component and source of information

Components of TB screening intervention	Intervention activity	Subcategory of adherence applicable	Activity score (maximum)	Source of information
Intensive TB case finding among PLHIV (ITCF) (HIV clinic performs these activities)	1. TB screening for PLHIV	Content	1	Interview
	2. Sputum evaluation of presumed TB cases	Content	1	Interview
	3. X-ray evaluation of presumed TB cases	Content	1	Interview
	4. Frequency of TB screening provision at the clinic	Frequency	3	Interview
	5. Screening coverage: proportion of PLHIV screened for TB	Coverage	1	TB and HIV register
IPT initiation (HIV clinic initiates IPT to these clients)	6. Specialized cases	Content	2	Interview
	7. Children under 5 years	Content	2	Interview
	8. All PLHIV	Content	2	Interview
	9. General TIC at the facility	Content	2	Interview
	10. Administrative measure	Content	1	Interview
	11. Environmental measure	Content	1	Interview

TB Infection contro TIC (DHs provides these activities)	12. Personal protective measure	Content	1	Interview
	13. Surveillance of TB among workers	Content	1	Interview
Programme review meeting (PRM) (HIV clinic performs or provide these activities)	14. TB and HIV review meeting	Content	1	Interview
	15. Uniform and quality data	Content	1	Interview
	16. Share and analyses data at all levels	Content	1	Interview
	17. Provide feedback to all levels	Content	1	Interview
	18. HIV clinic holds regular review meeting	Frequency	4	Interview
	19. Review meetings involve all HIV care providers	Coverage	2	Interview
Total	**19**		**29**	

As shown in Table 13, each of the four major components of the intervention comprise a different number of activities (ITCF 5; IPT 3: TIC 5; and PRM 6). Most of the activities were scored 0 (activity not implemented by the DH) or 1 (activity implemented by the DH). Other activities had a score ranging from 1 to 3. For instance, the scores for "frequency of TB screening" ranged from 1 (HIV clinic provides screening for TB on one day a week) to 3 (HIV clinic provides screening for TB on every day of the week) while the scores for "review meeting involve all HIV care providers" ranged from 0 (review meeting never include all HIV healthcare providers) to 2 (review meeting always includes all HIV healthcare providers). Respondents were also asked an open-ended question "how facility ensures TB infection control". The responses were post-coded into three activities (administrative, environmental and personal protective measures and surveillance of TB among workers) with scores of 0 (activity not implemented) or 1 (activity implemented). The total maximum possible adherence score from all the 19 activities was 29 (ITCF 7; IPT 6: TIC 6; and PRM 10) per DH (Table 13).

To examine differences in the facility characteristics between adherence levels, we collected data on the *geographical location* of the DH which is related to the physical location where the DH is situated in the country described by ecological zone (region and zone); *healthcare staffing level and workload* being the aspect of HIV healthcare providers and work distributions in the facility needed to facilitate the success of the implementation (these factors included the

numbers of HIV healthcare providers, PLHIV attending the HIV clinic per month, screened for TB per month, and calculated workload); and *physical facilities and resources* consisted of the aspect of inputs available to facilitate the success of the implementation, such as availability of TB screening questionnaire, TB screening guideline, TB IE&C materials and guidelines for infection control in the DH.

Data management and analysis

The data collected with the paper-based questionnaire were captured onto EpiData version 3.1 software while the service records data were captured in MS Excel. All the 27 facilities involved in the study were assigned 4-letter codes which were used on both datasets, with no identifiers. Both datasets were password-protected and imported into STATA 15 software [39] for cleaning and analysis.

We conducted baseline descriptive analysis of the characteristics of the respondents and the DHs. Descriptive statistics including percentages, ratios, median and interquartile ranges (IQR) were used to summarize the characteristics such as age, sex, profession, DH location, length of time working at the facility, education, and HIV healthcare providers workloads.

We determined adherence score for each of the four intervention components per DH by summing the activity (item) scores for each intervention component. Reliability check was conducted using

Cronbach's alpha for each of the four components of the TB screening programme at the facility level. An equally weighted additive method was further used by summing the four component adherence scores to generate an overall programme or facility adherence score per DH. These adherence scores were further expressed as percentages of the respective maximum possible scores for descriptive analysis. Because there is no known predefined cut-off point to define high or low programme adherence level, a median percentage score was calculated and used as a cut-off to categorise scores into high or low adherence. A percentage score below the calculated median percentage score of 62.1% was categorized as low adherence. This categorization was used to determine the programme adherence level for each facility, whether it fell within the low or high adherence category. The health facilities were described as high or low using proportion. A Mann-

Whitney U test, Spearman's correlation coefficient and Kruskal-Wallis tests at a 5% significance level were used to assess for statistically significant differences in facility characteristics between facilities with overall high adherence score and those with low score.

5.4 Results

Characteristics of the study participants

The study participants therefore consisted of 27 respondents, of which 18 (66.7%) were heads of facilities, 8 (29.7%) were facility TB/HIV coordinators, and 1 (3.7%) was the head of HIV clinic. We found from the study that the mean age of the respondents was 41.2 (standard deviation (SD)=8.7) and about half of the respondents (n=14, 51.9%) had worked in the facility for less than 5 years. Most of the respondents were males (n=22, 81.5%), had worked in their current position for less than 5 years and (n=15, 55.6%), were physicians (n=22, 81.2%), and had attained postgraduate as the highest level of education (n=21, 77.8%) as shown in Table 14.

Table 14: Characteristics of the study participants

Characteristics of respondents	Response Category	Number (%)
Role at the DH	Head of HIV clinic	1 (3.7)
	TB/HIV coordinator	8 (29.6)
	Head of the facility	18 (66.7)
Age in completed years (Mean & SD)		41.2 (8.7)
Gender	Female	5 (18.5)
	Male	22 (81.5)
Number of years working at the facility	<5years	14 (51.9)
	5 years plus	13 (48.1)
Number years working in current role	<5years	15 (55.6)
	5 years plus	12 (44.4)
Main occupation of respondent	Non-clinician	5 (18.5)
	Clinician	22 (81.5)
Highest educational level	Post-secondary non-tertiary	6 (22.2)
	Tertiary	21 (77.8)

Facility location (zone)	Savannah	7 (26.0)
	Forest	11 (40.7)
	Coastal	9 (33.3)

Note: DH=District Hospital, SD=Standard Deviation

Characteristics of the health facilities

Out of the 27 DHs studied, eleven were geographically located in the Forest zone, nine from Coastal and seven from the Savannah zones. All these DHs had HIV clinics that had adopted the integration of the TB screening intervention among the PLHIV attending the clinic. All the clinics operated five working days per week (excluding public holidays) and 8 hours a day from 8 O'clock in the morning with all providers certified by professional bodies accredited by Ghana Health Service. Table 15 provides a descriptive overview of the facilities included in the analysis. The number of HIV healthcare providers per facility ranged from 8 to 10. The monthly HIV clients attendance per facility vary with a median attendance of 609 (IQR: 182–1479) while the monthly median number of PLHIV screened for TB was 79 (IQR: 32–344). The median workload (HIV healthcare providers to HIV clinic attendance was 67 (IQR: 18–127). Most (74.1% and 77.8%) of the facilities have TB screening questionnaires and guidelines respectively available. However, other resources such as TB/HIV clinical manual, TB information, education and communication (IEC) materials and TB prevention and infection control guidelines were not available in most facilities. See Additional file2.docx which is a table (Table S2) providing descriptive information on the characteristics of the facilities by the HIV clinics.

Table 15: Characteristics of the health facilities by ecological zones

Variables	**Ecological zone Median (IQR), N (%)**				**p-value**
	All (N=27)	Savannah (n=7)	Forest (n=11)	Coastal (n=9)	
Median number of HIV healthcare providers per HIV clinic.	9 (8 - 10)	8 (7 – 8)	9 (7 – 11)	10.0 (10 – 10)	**0.018**
Median number of PLHIV attending the HIV clinic per month.	609 (182 – 1479)	600 (60 – 1023)	904 (257 – 4342)	475 (60 – 900)	0.177
Median number of PLHIV screened for TB per month.	79 (32 – 344)	69 (57 – 419)	200 (58 – 904)	32 (26 – 79)	0.313
Median number of patients per provider per monthly	67 (18 – 127)	66 (8 – 128)	113 (28 – 620)	43 (7 – 90)	0.157

TB screening questionnaire available					
No	7 (25.9)	1 (14.3)	2 (18.2)	4 (44.4)	
Yes	20 (74.1)	6 (85.7)	9 (81,8)	5 (55.6)	0.295
TB/HIV clinical manual available					
No	23 (83.2)	5 (71.4)	11 (100.0)	7 (77.8)	
Yes	4 (14.8)	2 (28.6)	0 (0.0)	2 (22.2)	0.187
TB screening Guideline available					
No	6 (22.2)	1 (14.3)	2 (18.2)	3 (42.7)	
Yes	21 (77.8)	6 (85.7)	9 (81,8)	6 (66.7)	0.606
TB IE&C materials available					
No Yes	24 (88.9)	6 (85.7)	11 (45.8)	7 (77.8)	0.276
	3 (11.1)	1 (14.3)	0 (0.0)	2 (22.2)	
TB prevention and infection control guideline available					
No Yes	23 (83.2)	5 (71.4)	11 (45.8)	7 (77.8)	0.187
	4 (14.8)	2 (28.6)	0 (0.0)	2 (22.2)	

Note: IE&C=Information, education and communication.

TB screening implementation fidelity

Adherence scores

The overall adherence score and scores for each of the four components of the TB screening of PLHIV intervention are presented by the boxplot in Figure 13.

The overall adherence score (summation of items of all components) for the facilities ranged from 48.3% to 82.8%, with a median of 62.1% (IQR: 58.6 – 65.1). The median scores for each of the four components differ. Median scores and IQR for the four components were: ITCF (85.7%; IQR: 85.7%, 100%); IPT (0; IQR: 0%, 66.7%); TIC (50%; IQR: 33.3%, 66.7%); and PRM (90%; 70%, 90%). Among the four components, PRM had highest score while the IPT component had the lowest score. Also, with the ITCF component, the 1st quartile and the

median scores were the same (85.7%) while the 3rd quartile and the maximum scores were also the same (100%). With the IPT component, the minimum score, the 1st quartile and the median were the same (0%) while the 3rd quartile and the maximum score were the same (66.7%). Similarly, with the PRM component, the median score and the 3rd quartile score was the same (90%). None of the components and the overall had an outlier score.

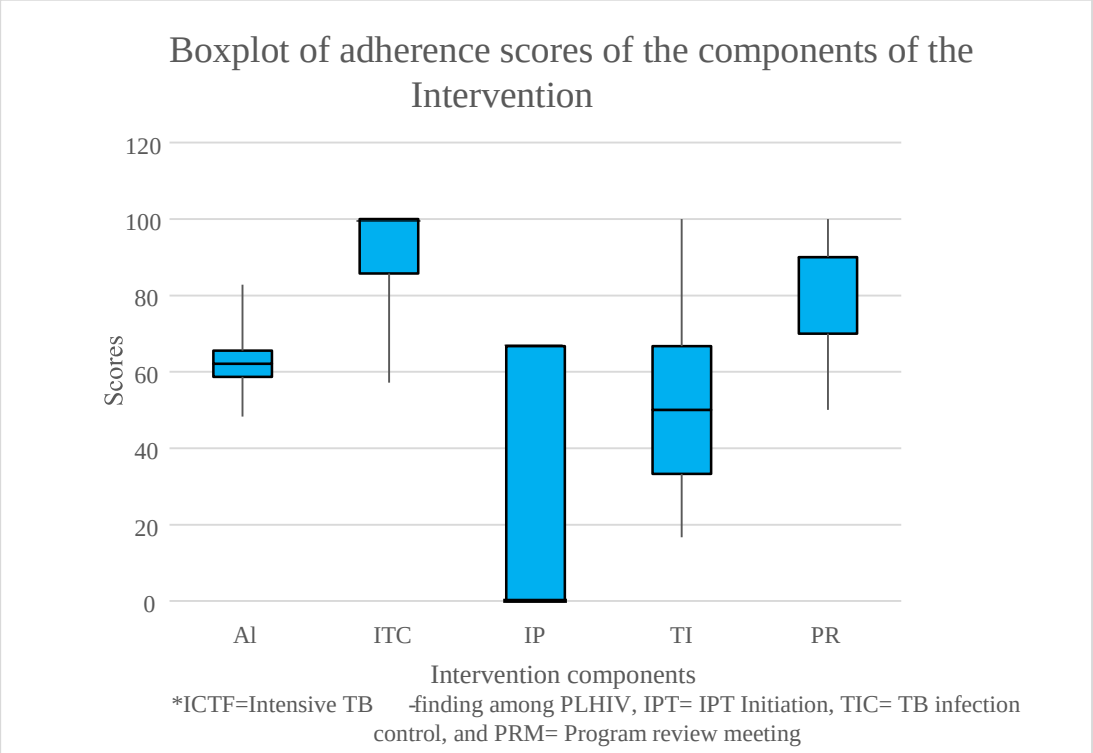


Figure 13: Boxplot showing the distribution of adherence scores of the TB screening intervention components

The internal consistency for each of the four intervention components (ITCF, IPT, TIC, and PRM) and the overall programme were 0.59, 0.94, 0.63, 0.57, and 0.69, respectively. As the calculated alpha approaches one, it indicates that the items measure the components as intended to well and are interrelated within the test [40,41].

Facility/programme adherence level

The programme adherence median score of 62.1% was used as the cut-off point to categorize the facilities into to a low or high adherence level. We found that 17 (63.0%) facilities scored ≥62.1% to fall in the high adherence category, while 10 (37.0%) facilities scored <62.1% to fall in the low adherence level category as showed by Figure 14

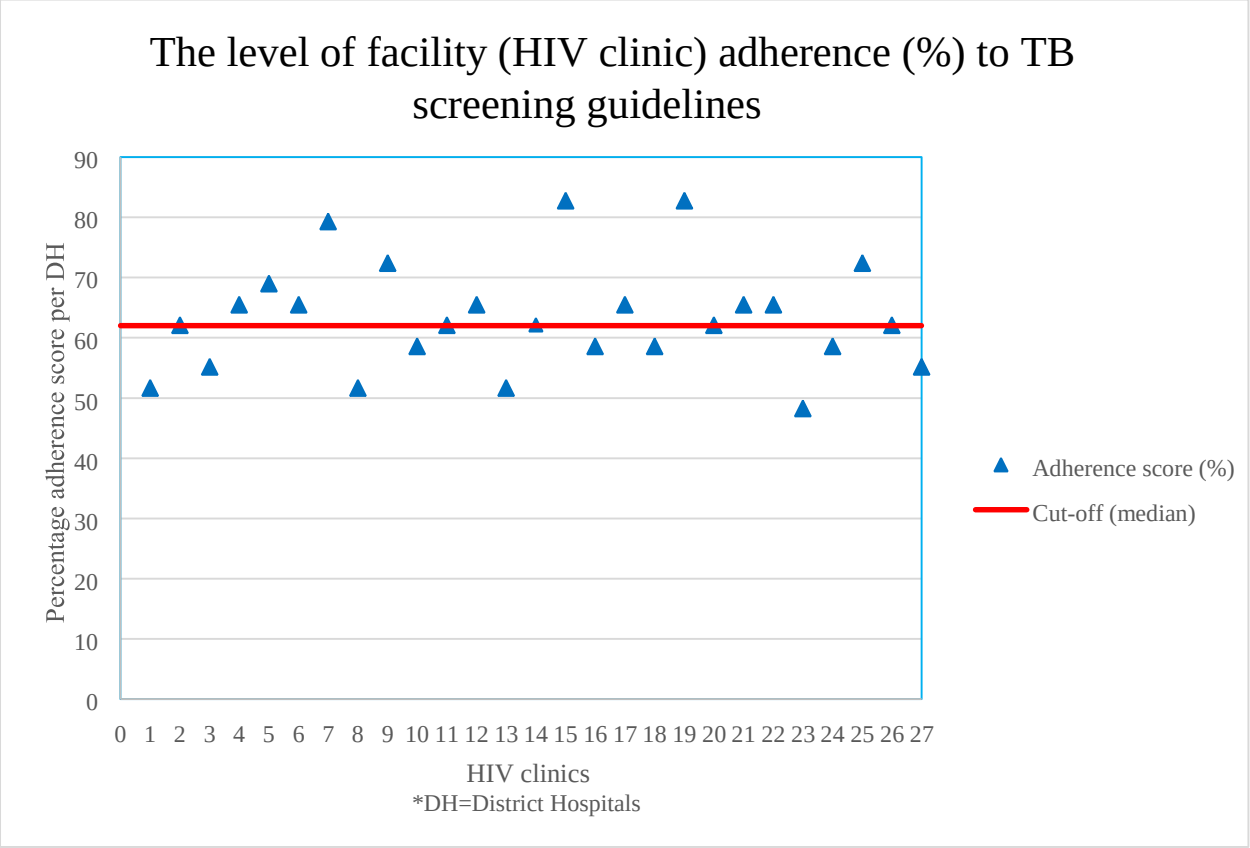


Figure 14: Graphical representation of the facility adherence score (%) to TB screening guidelines and activities at 27 HIV clinics

Differences in facility characteristics between high and low adherence level facilities

The characteristics of the facilities studied were grouped as geographical location, health facility utilization and staffing workload, and physical facilities and resources. In the Table 16, the assessment for significant differences in facility-level factors between the low and high adherence level facilities is presented.

Table 16: Association between facility-level factors and programme adherence level

Facility factors	Low adherence level N (%), Median (IQR)	High adherence level N (%), Median (IQR)	Significance
Geographical location			
Ecological zone			
Savannah	2 (28.6)	5 (71.4)	
Forest	5 (45.5)	6 (54.5)	*p=0.876
Coastal	3 (33.3)	6 (66.7)	
Physical facilities and resources			
TB screening questionnaire available			
No	6 (85.7)	1 (14.3)	
Yes	4 (20.0)	16 (80.0)	**^p=0.003**
TB/HIV clinical manual available			
No	9 (39.1)	14 (60.9)	
Yes	1 (25.0)	3 (75.0)	^p=0.370
TB screening guideline available			
No	5 (83.3)	1 (16.7)	
Yes	5 (23.8)	16 (76.2)	**^p=0.009**
TB IE&C materials available			
No	9 (37.5)	15 (62.5)	
Yes	1 (33.3)	2 (66.7)	^p=0.503
TB prevention and infection control guideline available			
No	9 (39.1)	14 (60.9)	
Yes	1 (25.0)	3 (75.0)	^p=0.370
Health facility utilization and staffing workload			
Median number of HIV healthcare providers per HIV clinic**.**	9.5 (8 – 10)	9 (8 – 10)	$^{\alpha}$p=0.726
Median number of PLHIV attending the HIV clinic per month.	900 (609 – 2622)	256 (60 – 904)	$^{\alpha}$**p=0.042**
Median number of PLHIV screened for TB per month.	74 (26 – 277)	200 (38 – 419)	$^{\alpha}$p=0.345
Median number of patients per provider per month	90 (66.7 – 263.5)	28.6 (8.6 – 113)	$^{\alpha}$**p=0.046**

*Note: * used Kruskal-Wallis test; ^ used Mann-Whitney U; and $^{\alpha}$ used Spearman's correlation coefficient to assess significance difference. IE&C=Information, education and communication*

The study shows that most DHs in the Savannah (71.4%), Coastal (66.7%) and Forest (54.6%) zones adhered to the implementation guidelines and activities (high adherence level); however,

the result showed that the mean adherence score was not statistically insignificant (p=0.876) between the three groups.

The findings showed that amongst the health facility utilization and staffing workload factors, the mean overall adherence score was statistically significant different in monthly patient load and provider workload between low and high adherence levels. Compared to the high adherence facilities, the low adherence facilities had a significantly higher median number of PLHIV attending HIV clinics per month (900; IQR: 609 – 2622 vs. 256; IQR: 60 – 904), and a significantly higher patient to provider ratio (p=0.046). The mean overall adherence score was not statistically significant different (p>0.05) for number of HIV healthcare providers or the number of PLHIV screened for TB at the facilities.

Among the physical facilities and resources factors, the study revealed that only the availability of TB screening questionnaire and TB screening guideline were significantly associated with adherence level. Most HIV clinics where TB screening questionnaires (80.0%) and TB screening guidelines (76.2%) were available, were in the high adherence group while most clinics without these documents for implementing the intervention were in the low adherence group (p<0.01). We found that the mean overall adherence score was not statistically significant different in the availability of TB/HIV clinical manual (p=0.589), TB IE&C materials (p=0.888), and TB prevention and infection control guidelines (p=0.589) between adherence levels.

5.5 Discussion

This study used a cross-sectional design to investigate the adherence level to programme guidelines for implementing the TB screening activities at the HIV clinics and related facility factors at selected HIV clinics in Ghana. Our study found seventeen (63.0%) of the 27 facilities had a high adherence level meaning they implemented most of the activities in the clinic according to the intervention guidelines. The intervention component with the highest adherence score was programme review meeting (PRM) followed by intensive TB case-finding among PLHIV (ITCF) and then TB infection control (TIC) components while the IPT component scored the least among the four components. Although over half the number of DHs studied implement the TB screening intervention with high level adherence to the

guideline, the difference in the proportion is suboptimal. The low adherence scores for TIC and especially IPT by some HIV clinics could explain why about 37% of the facilities were in the low programme adherence level. Similarly, Fagan J A, 1990 found in their Violent Juvenile Offender Program that intervention sites that received moderate to high adherence scores or ratings in implementing most of the core components of the program fared much better compared to sites that received weak to moderate scores [42]. Contextual adaptation by modifying what may be adaptable and maintaining the critical components with their respective items may be needed to enhance adherence to TIC and IPT components [43,44]. Nonetheless, actual reasons for the low adherence to TIC and IPT which would inform scale-up, scale-out and process evaluation needs further research.

The WHO recognizes that implementation guidelines promote standardization and simplification in implementing an effective intervention [45,46] in real life. But, suboptimal facility adherence level to intervention guidelines is known to result in an unsuccessful intervention outcome [47,48]. Thus, the finding of this study provides a possible explanation for the low and fluctuating TB screening coverage among PLHIV attending HIV clinics in Ghana, an observation that led to the revision of the TB/HIV collaborative guideline with newly set targets in 2014 [5]. With the facility adherence level found in our study, it will be quite challenging to achieve the 2018 target of 80% TB screening coverage among PLHIV at the HIV clinic in Ghana. No previous study on facility adherence or fidelity on TB screening guidelines available.

Adherence as a determinant of failure or success of the implementation of an intervention is influenced by important factors [49] of which some are related to the organization in which the intervention is being implemented. Given the relationship between facility or organizational factors and how an intervention is implemented in a health facility [25], we examined facility-level factors that were relevant and likely to have an impact on the implementation of the intervention in several studies, including geographical location, staffing and workload, and facility resources [49–53]. Some of these factors examined appeared to have little influence on the adherence level. For example, the relationship between geographical location (being in Savannah, Forest or Coastal zones of Ghana) and programme adherence level was not statistically significant. Notwithstanding, we found some variability between geographical location on level of adherence in the implementation of the TB screening intervention, with facilitates in the Savannah zone having higher adherence compared to the Coastal and Forest

zones in that order. In terms of HIV prevalence, the Ghana Demographic and Health Survey report (2014) showed that, most regions in the Savannah zones have the lowest prevalence rates, followed by Coastal zone while the Forest zone has the region with the highest rate [54]. This corroborates our findings that, the Forest zone has the highest median number of PLHIV attending the HIV clinics per month [55,56]. The variability in adherence levels observed across geographical zones could be due to fewer number of PLHIV attending HIV clinics in Savannah than Forest zones per month. However, our findings may be a function of the small number of sample (27 facilities) involved in the study and insufficient power to conduct robust statistical analyses to test for association. Nonetheless, our findings are consistent with other studies [57,58].

We also explored the relationship between adherence level and other facility characteristics covering healthcare staffing levels and workloads. We found that facilities with high programme adherence level had significantly lower numbers of PLHIV attending the HIV clinic per month and lower HIV healthcare provider-HIV client ratios than facilities with low programme adherence level. Although there is no significant difference in the number of HIV healthcare provider between the adherence levels, inversely, high adherence level facilities screened more PLHIV for TB than low adherence level facilities; however, the difference is not significant. Facilities seeing more clients screened less PLHIV for TB. Systematic reviews [59,60] confirmed earlier assertions that provider staffing is associated with intervention outcomes. The provider-patient ratio and the caseload were found to be influencers of implementation outcomes [56,61] such as fidelity. These findings corroborate our results. Our study further shows that most HIV clinics without the TB screening questionnaire on-site had low level of adherence adhere to the guidelines for implementing the intervention. This finding is consistent with the Global Fund 2018 report on best practices on TB case finding and treatment which indicated that the absence of TB screening questionnaire at the point of service delivery is a possible hindrance to screening PLHIV, TB cases identification and TB outcomes improvement [62]. Availability of guidelines promotes a step-by-step process to a successful implementation of health intervention [63]. Van de Glind et al. (2015) report in their multi-case study that availability of protocols, procedures and agreements supporting the implementation of the intervention influences adherence [64]. However, our study found that other resources such as availability of TB/HIV clinical manual, TB IE&C manual and TB prevention and infection control guideline do not vary with the programme adherence levels.

Limitation

It is worth mentioning that albeit with some promising findings in this study, there are also some limitations to be considered in the interpretation of the results. Firstly, due to our selection procedure, respondents were mostly proponents' heads of the facility. On the other hand, because of the role and experience in implementing the intervention, respondents were able to provide rather detailed answers to our questions. Secondly, a limitation of concern is the external validity of the findings. The study was conducted in 27 district hospitals, and it is unclear to what extent these findings can be generalized to other district hospitals in Ghana. All the same, it was a census-based survey of all the facilities that met our inclusion criteria. We interpret these data with caution. Also, the median as a cut-off to determine high or low adherence facility does not take into account the magnitude or the distribution of the score across the samples, but because the 27 facility adherence scores were not normally distributed the non-parametric test conducted was appropriate. Thirdly, it should be noted that this study did not investigate the patients' perspective. It would be valuable to add their contribution to the factors found in this study. Finally our calculated Cronbach's alpha were generally low. However, the components (ITCF and PRM) with low alpha (0.59 and 0.57 respectively) had a higher adherence score compared to the components (IPT and TIC) with high alpha (0.94 and 0.63 respectively). Although alpha is widely used, the low level observed in this study might either be due to low number of items measuring the specific component or probably not a good measure of internal consistency or reliability for the ITCF and PRM components in our study.

5.6 Conclusion

A majority of the district hospitals implemented the intervention guidelines as is. Adherence was higher for intensive case-finding among PLHIV and programme review meeting intervention components and lower for IPT initiation and TB infection control intervention components. The programme adherence level observed by the DHs may explain the low and fluctuating intervention outcomes observed over the past years. Evidence from our study confirmed an association between programme adherence level and facility characteristics related to *health facility utilization and staffing workload,* and *physical facilities and resources*.

We recommend that NTP must highlight and re-emphasize the importance of implementing the activities of these components fully through meetings, trainings and engagements. This

could improve adherence for IPT initiation and TB infection control intervention components. Given the lack of programme adherence level studies, our study adds to implementation science literature by assessing adherence level of health facilities implementing an intervention.

Reference

1. World Health Organization. Global tuberculosis report 2015. Geneva, Switzerland; 2015.
2. World Health Organisation. Global tuberculosis report 2019. Geneva; 2019 Oct.
3. Biermann O, Lönnroth K, Caws M, Viney K. Factors influencing active tuberculosis casefinding policy development and implementation: A scoping review. BMJ Open. 2019 Dec 11;9(12):e031284.
4. WHO. WHO policy on collaborative TB/HIV activities Guidelines for national programmes and other stakeholders. 2012.
5. Ghana Health Service. Implementation of TB/HIV collaborative activities in Ghana: Joint programme planning policy and guidelines. 2014.
6. Habib AG. A clinical and epidemiologic update on the interaction between tuberculosis and human immunodeficiency virus infection in adults. Vol. 8, Annals of African Medicine. Medknow Publications and Media Pvt. Ltd.; 2009. p. 147–55.
7. Date A, Modi S. TB Screening Among People Living With HIV/AIDS in ResourceLimited Settings. JAIDS J Acquir Immune Defic Syndr. 2015 Apr 15;68:S270–3.
8. WHO. Global TB Report 2017. 2018.
9. Owiti P, Onyango D, Momanyi R, Harries AD. Screening and testing for tuberculosis among the HIV-infected: Outcomes from a large HIV programme in western Kenya 11 Medical and Health Sciences 1117 Public Health and Health Services 11 Medical and Health Sciences 1103 Clinical Sciences. BMC Public Health. 2019 Jan 8;19(1):29.
10. Getahun H, Kittikraisak W, Heilig CM, Corbett EL, Ayles H, Cain KP, et al. Development of a Standardized Screening Rule for Tuberculosis in People Living with HIV in Resource-Constrained Settings: Individual Participant Data Meta-analysis of Observational Studies. Murray M, editor. PLoS Med. 2011 Jan 18;8(1):e1000391.
11. World Health Organization W. Global Tuberculosis Report 2018. 2018.

12. The Global Fund. Assessment and Best Practices of Joint TB and HIV Applications Progress, Challenges, and Way Forward itle). Geneva, Switzerland; 2019.
13. CDC. Ghana Country Profile [Internet]. 2019 [cited 2020 May 12]. Available from: https://www.cdc.gov/globalhivtb/where-we-work/region/westafrica/ghana/ghana.html
14. Ghana Health Service. Implementation of TB / HIV collaborative activities in Ghana: Technical policy and guidelines. 2007.
15. World Health Organization W. System screening for active tuberculosis: an operational guide. Geneva, Switz. 2015;(WHO/HTM/TB/2015.16).
16. Getahun H. Screening and diagnosing TB in PLHIV : Challenges and ways forward Collaborative TB / HIV activities. 2008;
17. Abebe R, Fantahun M, Hailemicheal Y, Yizengaw M, Zegeye MM. Hiv testing and counseling among patients with tuberculosis at arbaminch hospital, Southern Ethiopia. Am J Trop Med Hyg. 2014;89(5):232.
18. National AIDS/STI Control Programme. Ghana NACP Annual Report, 2019. National AIDS/STI Control Programme. 2020.
19. Ho J, Fox GJ, Marais BJ. Passive case finding for tuberculosis is not enough. Vol. 5, International Journal of Mycobacteriology. Elsevier Ltd; 2016. p. 374–8.
20. Proctor E, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, et al. Outcomes for
Implementation Research : Conceptual Distinctions , Measurement Challenges , and Research Agenda. 2011;65–76.
21. Carroll C, Patterson M, Wood S, Booth A, Rick J, Balain S. A conceptual framework for implementation fidelity. Implement Sci. 2007 Dec;2(1):1–9.
22. Bahrami M, Deery C, Clarkson JE, Pitts NB, Johnston M, Ricketts I, et al. Effectiveness of strategies to disseminate and implement clinical guidelines for the management of impacted and unerupted third molars in primary dental care, a cluster randomised controlled trial. Br Dent J. 2004 Dec 11;197(11):691–6.
23. College of Physicians R. National clinical guideline for stroke Fourth edition Prepared by the Intercollegiate Stroke Working Party. 2012.
24. Medicine AC of S. ACSM's Health/Fitness Facility Standards and Guidelines - American College of Sports Medicine - Google Books [Internet]. [cited 2020 Oct 27]. Available from: https://books.google.co.za/books?hl=en&lr=&id=Du96DwAAQBAJ&oi=fnd&pg=PP17& dq=facility+guidelines&ots=VvGO-

2hoyh&sig=dFt7E4onNPBTHUntfFHcoCrdl3E&redir_esc=y#v=onepage&q=facility guidelines&f=false

25. Hughes, Carmel M.; Lapane KL. MV. Influence of Facility Characteristics on Use of Antipsychotic Medications in Nursing Homes on JSTOR. Med Care. 38(12):1164–73.
26. Intrator, Orna; Castle, Nicholas G.; Mor V. Facility Characteristics Associated With Hospitalization of... : Medical Care. Med Care. 37(3):228–37.
27. Lau DT, Kasper JD, Potter DEB, Lyles A. Potentially inappropriate medication prescriptions among elderly nursing home residents: Their scope and associated resident and facility characteristics. Health Serv Res. 2004 Oct 1;39(5):1257–76.
28. Dabaro D. Factors affecting tuberculosis case detection in Kersa District, South West Ethiopia. J Clin Tuberc Other Mycobact Dis. 2017 Dec 1;9:1–4.
29. City-Population. Ghana: Administrative Division (Regions and Districts) - Population Statistics, Charts and Map [Internet]. 2019 [cited 2020 Jun 8]. Available from: https://www.citypopulation.de/en/ghana/admin/
30. Ghana Health Service. THE HEALTH SECTOR IN GHANA. Accra; 2018.
31. Ghana Health Service. Implementation plan for IPT, Ghana [Internet]. 2017 [cited 2018 Jul 24]. Available from: https://www.google.co.za/search?q=IPT+for+TB+prevention+in+Ghana&oq=IPT+for+TB+prevention+in+Ghana&aqs=chrome..69i57.12706j1j8&sourceid=chrome&ie=UTF-8
32. Beehler GP, Funderburk JS, Possemato K, Vair CL. Developing a measure of provider adherence to improve the implementation of behavioral health services in primary care: a Delphi study. Implement Sci. 2013 Dec 13;8(1):19.
33. Becker DR, Smith J, Tanzman B, Drake RE, Tremblay T. Fidelity of supported employment programs and employment outcomes. Psychiatr Serv. 2001;52(6):834–6.
34. Abry T, Hulleman CS, Rimm-Kaufman SE. Using Indices of Fidelity to Intervention Core Components to Identify Program Active Ingredients. Am J Eval. 2015 Sep 6;36(3):320–38.
35. Durlak JA, DuPre EP. Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. Am J Community Psychol. 2008 Jun;41(3–4):327–50.
36. Backer TE. Finding the balance: program fidelity and adaptation in substance abuse prevention: a state-of-the-art review. Rockville, MD Cent Subst Abus Prev. 2002;

37. Ghana Health Service. Implementation Plan for Isoniazid Preventive Therapy in Ghana. 2017.
38. Lebina L, Alaba O, Ringane A, Hlongwane K, Pule P, Oni T, et al. Process evaluation of implementation fidelity of the integrated chronic disease management model in two districts, South Africa. BMC Health Serv Res. 2019 Dec 16;19(1):1–14.
39. StataCorp. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC. 2017.
40. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ. 2011 Jun 27;2:53–5.
41. Spiliotopoulou G. Reliability reconsidered: Cronbach's alpha and paediatric assessment in occupational therapy. Aust Occup Ther J. 2009 Jun 1;56(3):150–5.
42. Fagan JA. Treatment and Reintegration of Violent Juvenile Offenders: Experimental Results | Office of Justice Programs. Justice Q. 1990;7(2).
43. Anyon Y, Roscoe J, Bender K, Kennedy H, Dechants J, Begun S, et al. Reconciling Adaptation and Fidelity: Implications for Scaling Up High Quality Youth Programs. J Prim Prev. 2019;40(1):35–49.
44. Aarons GA, Sklar M, Mustanski B, Benbow N, Brown CH. "Scaling-out" evidence-based interventions to new populations or new health care delivery systems. Implement Sci 2017 121. 2017 Sep 6;12(1):1–13.
45. Grimshaw J, Freemantle N, Wallace S, Russell I, Hurwitz B, Watt I, et al. Developing and implementing clinical practice guidelines. Vol. 4, Quality in health care : QHC. BMJ Publishing Group; 1995. p. 55–64.
46. Wang Z, Norris SL, Bero L. Implementation plans included in World Health Organisation guidelines. Implement Sci. 2016 May 20;11(1):76.
47. Breitenstein SM, Gross D, Garvey CA, Hill C, Fogg L, Resnick B. Implementation fidelity in community-based interventions. Res Nurs Health. 2010 Apr;33(2):164–73.
48. Yano EM, Green LW, Glanz K, Ayanian JZ, Mittman BS, Chollette V, et al. Implementation and spread of interventions into the multilevel context of routine practice and policy: implications for the cancer care continuum. J Natl Cancer Inst Monogr. 2012 May;2012(44):86–99.
49. Fischer F, Lange K, Klose K, Greiner W, Kraemer A. Barriers and Strategies in Guideline Implementation—A Scoping Review. Healthcare. 2016 Jun 29;4(3):36.

50. Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud P-AC, et al. Why Don't Physicians Follow Clinical Practice Guidelines? A Framework for Improvement. Vol. 282, JAMA. 1999.
51. Ennett ST, Haws S, Ringwalt CL, Vincus AA, Hanley S, Bowling JM, et al. Evidencebased practice in school substance use prevention: fidelity of implementation under realworld conditions. Health Educ Res. 2011 Apr;26(2):361–71.
52. Howard AA, El-Sadr WM. Integration of Tuberculosis and HIV Services in Sub-Saharan Africa: Lessons Learned. Clin Infect Dis. 2010;50(S3):238–44.
53. Fleuren MAH, Paulussen TGWM, Dommelen P, Buuren S Van. Towards a measurement instrument for determinants of innovations. Int J Qual Heal Care. 2014 Oct 1;26(5):501–
10.
54. Statistical Service Accra G. Ghana Demographic and Health Survey 2014. 2015;
55. Nilsen P, Bernhardsson S. Context matters in implementation science: A scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. Vol. 19, BMC Health Services Research. BioMed Central Ltd.; 2019. p. 189.
56. Ansa GA, Sifa JS. Tuberculosis and HIV integration in sub-Saharan Africa. Asian Pacific J Trop Dis. 2015;5(11):841–9.
57. Asamani JA, Ismaila H, Plange A, Ekey VF, Ahmed AM, Chebere M, et al. The cost of health workforce gaps and inequitable distribution in the Ghana Health Service: an analysis towards evidence-based health workforce planning and management. Hum Resour Health. 2021;19(1):1–15.
58. Inegbedion H, Inegbedion E, Peter A, Harry L. Perception of workload balance and employee job satisfaction in work organisations. Heliyon. 2020;6(1):e03160.
59. Lankshear, J. Annette; Sheldon, A. Trevor; Maynard A. Nurse Staffing and Healthcare Outcomes: A Systematic Review of the International Evidence. Adv Nurs Sci. 2005;28(2):163–74.
60. Kane, L. Robert; Shamliyan, A. Tatyana; Muller, Christine; Duval, Sue; Wilt JT. The Association of Registered Staffing Levels and Patient Outcomes: Systematic Review and Meta-Analysis. Med Care. 45(12):1195–204.
61. Okot-Chono R, Mugisha F, Adatu F, Madraa E, Dlodlo R, Fujiwara P. Health system barriers affecting the implementation of collaborative TB-HIV services in Uganda. Int J Tuberc Lung Dis. 2009;13(8):955–61.

62. The Global Fund. Best Practices on TB Case Finding and Treatment Reflections and Lessons from West and Central Africa and Beyond. 2018.
63. Tetelbom A, Migowski A. Implementing clinical guidelines: a need to follow recommendations based on the best evidence available Implementação de diretrizes clínicas: a necessidade de seguir recomendações com base na melhor evidência disponível. Rev BRas epidemiol. 2018;21:180021.
64. Van De Glind I, Heinen M, Geense W, Mesters I, Wensing M, Van Achterberg T. Making the connection - Factors influencing implementation of evidence supported and nonevaluated lifestyle interventions in healthcare: A multiple case study. Health Educ Res. 2014 Nov 18;30(4):521–41.

6.0 Determinants of Implementation of TB Screening Intervention

In this chapter, we present the third paper which was submitted and under review for publication (the original draft is attached as appendix C). The paper covers objective 6 of the study. This result chapter includes an introduction, methods, results and discussion sections with the list of references cited in the paper. It explores the determinants that influence the delivery of the TB screening program at ART/HIV clinics within district hospitals in Ghana. The factors identified were classified either as a facilitator or barriers as presented below.

6.1 Abstract

Background: Decreasing the burden of TB among PLHIV through TB screening is an effective intervention recommended by the WHO. However, after over a decade of implementation in Ghana, the intervention does not realise the expected outcomes. It is also not well understood whether this lack of success is due to implementation barriers. Our study, therefore, sought to examine the factors influencing the implementation of the intervention among PLHIV attending HIV clinics at district hospitals in Ghana.

Methods: This was a qualitative study conducted from 6th to 31 May 2019 in three regions of Ghana. We conducted 17 in-depth interviews (IDIs – comprising 2 regional, 6 districts and 9 facility TB/HIV coordinators) and 8 focus group discussions (FGD – consisting of a total of 65 participants) with HIV care providers. All responses were digitally audio-recorded and transcribed verbatim for coding and analysis using the Framework Approach. Participants consented to the interview and recording.

Results: The main barriers to TB screening relate to the low commitment of the implementers to screen for TB and limited facility infrastructure for the screening activities. Facilitators of TB screening include (1) ease in TB screening, (2) good communication and referral channels, (3) effective goals and feedback mechanisms, (4) health workers recognising the need for the intervention and (5) the role of chemical sellers.

Conclusions: Key barriers and facilitators to the intervention are revealed. The study has shown that there is a need to increase HIV care providers and institutional commitment towards

TB screening interventions. In addition, cost issues need to be assessed as they are drivers of sustainability. Our study also advances the field of implementation science through Consolidated Framework for Implementation Research (CFIR) to better understand the factors influencing the implementation.

Keywords: Barriers, Enablers, factors, TB screening, PLHIV, Ghana

6.2 Introduction

Even though much progress has been made in the fight against Tuberculosis (TB) and HIV coinfection globally, they continue to be the main public health threats and health systems concerns in many low- and middle-income countries [1,2]. The World Health Organization (WHO) global report on TB recognises TB as the main cause of ill-health and death among people living with HIV (PLHIV) worldwide, and especially in resource-challenged settings [3–5]. In fact, in 2018, about 17% (251,000/1,491,000) of TB related deaths were in PLHIV [6]. Notwithstanding, globally, the TB deaths among PLHIV had declined over time, by 44%, from 534,000 in 2000 to 300,000 in 2017 [7]. According to the same report, about 51% of reported TB cases were from PLHIV [7]. The impact of these two diseases has been immense on the performance of health systems in poorly resourced countries and led to a reduction in global targets [8], particularly in sub-Saharan Africa [9].

Early diagnosis and effective treatment of TB cases in PLHIV can avert many deaths [7,10,11]. To end the dual epidemics of TB and AIDS by 2030, ensuring people are healthy and supporting the well-being of all TB and HIV patients is a prominent strategy of the WHO and Joint United Nations Programme on HIV/AIDS (UNAIDS) [7]. The WHO recommends the following three policy packages to control the TB/HIV burden: *(1)* establish the mechanism for collaboration between TB and HIV program activities; *(2)* reduce the burden of TB among PLHIV, and *(3)* decrease the burden of HIV among TB clients [12]. The second package – which is the focus of this study – is made up of three intervention groups termed as the Three I's specifically; intensify

TB case finding (ICF), isoniazid preventive therapy (IPT), and infection control for TB [12,13]. Among these interventions, the WHO recognised ICF, done through TB screening among

PLHIV, as effective in reducing the burden of TB among PLHIV [13,14]. For example, in Ethiopia, TB screening effectively-identified 39% of PLHIV as presumptive TB cases, of which 6% were confirmed with Xpert machine [15]. ICF was defined as "the systematic identification of people with presumptive active TB, in a predetermined target group, using tests, examinations or other procedures that can be applied rapidly" [16]. For PLHIV, ICF would mean systematically screening for tuberculosis at every encounter with a health provider, among PLHIV, the high-risk population for HIV, or those living in mass population settings [17].

TB screening intervention ensures early detection of TB status followed by appropriate TB treatment or IPT among PLHIV [18]. Nonetheless, vast and persistent gaps exist in the detection and treatment of TB, including in PLHIV, especially in Sub-Saharan Africa [7]. For example, in 2017, only 64% of the estimated 10 million TB cases expected were reported, and most of the bottlenecks in detection and subsequent treatment of TB exist in the WHO Africa region where the burden of HIV co-infected with TB is highest [7].

Ghana adopted and implemented the TB screening intervention to reduce the burden of TB among PLHIV [19]. In the 2015 global TB report, Ghana was listed among the forty-one countries with TB/HIV co-infection burden with the highest estimated numbers of TB incidences that accounted for 97% of the global total [20]. In 2017, Ghana recorded an estimated TB incidence of 152 cases TB mortality of 36 per 100 000 population [21]. Also, in the same year, about 21% diagnosed with TB had HIV [21]. Ghana started the TB screening of PLHIV in 2007, with plans to implement the IPT component in 2018. The intervention in Ghana is such that all PLHIV attending HIV clinics must routinely be screened for TB with the aid of a simple questionnaire approved by WHO. The WHO-approved four-symptom questionnaire asks PLHIV for the presence of cough of any duration, fever, weight loss, and night sweats [22]. The presence of one or more symptoms means a positive screening, which requires further TB confirmatory testing through Xpert MTB/RIF (*Cepheid, CA, USA*) [23–25] and other possible tests, including sputum smear microscopy, culture for *Mycobacterium tuberculosis* and chest X-ray [26,27]. Those with confirmed TB are put on appropriate TB treatment, while those without TB may be initiated on IPT when available [28].

A review of literature on program indicators for Ghana shows that during the early stages (from 2008 to 2012) of the implementation of the TB screening intervention, a high proportion of PLHIV (70% – 96%) were screened for TB at HIV care clinics [29]. Unfortunately, this

observed success has not been sustained as programme data further revealed that in the years 2013 and 2014, approximately 20% [29] and 59% [30] of PLHIV, respectively, were screened for TB as part of care. Moreover, between 2010 and 2014, no clear screening target was set. The guideline, as a result, was revised in 2014 with new TB screening targets set at 56% for 2015, and progressively increasing the target to 80% in 2018 and further progress to 90% in 2020 [29]. But in 2018 and 2020, 40% and 44% TB screening coverage were achieved, respectively, far below the annual target. Such slow and fluctuating progress and not sustaining coverage in Ghana is unknown since no research has been conducted to that effect. Implementation science is crucial in identifying and addressing implementation gaps when evidence-based interventions are delivered into routine practice. Such identified gaps can inform appropriate strategies for successful implementation. Despite over a decade that the TB screening intervention has been implemented in Ghana, little information is known about factors that influence its implementation. Hence, the current research has the potential of addressing this gap. To the best of our knowledge, this marks the first study to examine the factors (barriers and facilitators) influencing the implementation of TB screening among PLHIV with the WHO approved questionnaire.

Our study was guided entirely by the Consolidated Framework for Implementation Research (CFIR) [31], one of the many determinant frameworks available for understanding contextual and other factors influencing the implementation of intervention of proven effectiveness [32]. It is a comprehensive framework in implementation science [31]. It was developed to guide the successful implementation of interventions through ascertaining factors that may influence the implementation of the TB intervention in a given setting. This could help identify potential strategies for overcoming any challenges before the implementation.

The CFIR comprises five domains: intervention characteristics, outer setting, inner setting, characteristics of individuals, and implementation process. The process domain entails planning, engaging, executing, and reflecting and evaluation that can only be ascertained in either a spiral or incremental approach to the implementation process [31], e.g., using the plan-do-study-act method through observation. Considering the focus of our study, we are therefore unable to include the process domain. We, therefore, chose the domains which were relevant and feasible to assess in the context of our study, defined as follows [31,33–35]:

1. *Intervention characteristics*: features of the TB screening intervention that may influence its effective implementation in Ghana. It comprises its perceived internal or external origin, evidence quality and strength, relative advantage, complexity and cost.

2. *Outer setting*: concerns with external influences (factors outside the HIV care clinics) on implementation of TB screening comprising availability of resources, incentives, communication and networking among HIV care clinics in Ghana.

3. *Inner setting*: relates to characteristics within the health facilities delivering the intervention. These include stakeholders, compatibility and relative priority of the TB screening intervention, goal-setting and feedback and the implementation climate.

4. *Individuals' characteristics*: concerns with health care providers and TB/HIV coordinators personal factors that may affect the implementation of the TB screening intervention. It consisted of health care providers' knowledge, beliefs, age, and years of practising and professional background.

6.3 Methods

Aim and design

We conducted an exploratory and purely qualitative study using in-depth interviews (IDIs) and focus group discussions (FGDs) on understanding the barriers and facilitators of implementing the TB screening intervention among PLHIV attending HIV clinics in the Northern, Eastern and Central regions of Ghana. The CFIR [31] guided the design, interview guides, data collection and analysis and reported in line with the Standard for Reporting Qualitative Research (SRQR) [36].

Setting of the study and the intervention

This study is part of a more extensive study conducted in Ghana. Ghana has ten traditionally administrative regions. The regions are subdivided into 216 districts, with most districts having a district hospital. There were 144 district hospitals, out of which 100 had HIV clinics while conducting this study. The national TB program plan was to initiate IPT among PLHIV with a negative TB screen at HIV clinics in Ghana, and 27 district hospitals were earmarked to start the implementation in 2018, after which it would be scaled up to other district hospitals [19] as described and published elsewhere [37,38]. Therefore, the main study was conducted in the 27 district hospitals across all the regions. Also, the ten regions were grouped into three ecological zones (Savannah, Forest and Coastal). One region was randomly selected from each zone to conduct this study. Therefore, this study was conducted in the three chosen randomly regions and their respective districts and district hospitals that were part of the extensive study (the 27 district hospitals).

The National Tuberculosis Programme (NTP) designed the TB screening intervention and implemented it through a cascading process at the regional, district, and facility levels and coordinated by TB/HIV collaborative committees. At each level, the committee is made up of members of the respective management team and the TB/HIV coordinator. The committee meet regularly to plan and coordinate joint TB/HIV activities at their respective levels for the NTP and NACP to incorporate into their specific plans for the implementation and supervision of the intervention. A TB/HIV coordinator was appointed "to be responsible for the day to day running of programme implementation and oversight of TB/HIV collaborative activities" [29]. At the same time, the healthcare providers at the HIV clinics deliver the intervention to PLHIV.

Characteristics of the interviewees, recruitment, and sample selection

We gathered information from TB/HIV coordinators and HIV care providers. Based on the three zones of Ghana, we randomly selected one region from each of the zones to make up three regions. The districts health directorates and district hospitals in the three randomly selected regions that were included in the more extensive study were all involved in this study. We purposively selected the regional, district and facility TB/HIV coordinators to conduct IDIs to elicit information mainly at the facility level while HIV healthcare providers working in the HIV clinics for at least one year were selected to conduct FGDs to gather information at the provider level. Healthcare providers who did not provide direct care to PLHIV and unavailable

TB/HIV coordinators at the research time were excluded. The head of the field team selected participants with support from colleagues and the head of HIV clinics in the case of the FGDs.

Pre-informatory letters were sent to the selected region and districts directors of health services and the facilities involved, informing them of the study. Potential participants were noted and approached on the day of the data collection. Participants were recruited based on availability, especially for the FGDs and interview appointments were explicitly booked for the IDIs when an eventuality occurred. All the participants consented before participation. In all, 17 TB/HIV coordinators (2 regional, 6 district and 9 facilities) and 65 HIV healthcare providers were included.

Data collection

IDI and FGD guides were developed based on the four domains in the CFIR framework that we had identified to apply to our study. The IDI guide partly focused on the characteristics of individuals' domains which relates more to the provider level. The FGD guide also concentrated on the inner setting domains, which relate to the facility level. In addition, both guides also covered the intervention characteristics and outer setting domains. Fact-to-face IDIs were conducted with TB/HIV coordinators and FGDs with HIV healthcare providers.

Three field officers (4 members per team) worked in one region each to collect data for this study. The teams had 5-days of practical training, including role-play on the IDI and FGD guides. The IDIs and FGDs were conducted in English and audio-recorded using digital voice recorders under the permission and consent of the participants. The FGDs were between 7 – 10 participants, depending on availability. Interviews and discussions were held in isolated, convenient and conducive places to ensure privacy. Interview recording times ranged from about 45 minutes to about 70 minutes. Data collection was from 6th to 31st May 2019.

The audio-recorded interviews and discussions were transcribed verbatim for analysis. SNB listened to the audiotapes, compared them with the transcripts and edited them when needed to ensure the transcripts had the same information as the audiotapes. The audio recording was also used to fill in gaps in the notes. SAO reviewed and imported the transcripts into MaxQDA Analytics Pro Software 2020 for coding based on the CFIR. To ensure anonymity, responses

from study participants, unique numbers had been assigned to participants and were used when presenting quotes from each respondent under the result section.

Data analysis

The study's data was analysed by SNB and SAO using the Framework Approach [39], which applies both inductive and deductive methods. The framework approach involves six iterative steps being (1) familiarisation with the data, (2) generating initial codes or assignment of primary codes to the dataset to describe the content, (3) searching for patterns and codes across the different interviews, (4) codes revision, (5) codes definition and (6) producing the report through the interpretation of results was adopted. The inductive method involved steps 1 and 2, while the deductive method involved steps 3 to 6. The codes were discussed and compiled into a codebook to guide the coding and categorisation of the data. The deductive analysis approach involved coding units of data according to the CFIR, with themes categorised based on defined factors (barriers or facilitators).

On the other hand, the inductive approach was used to identify new themes or unexpected findings aside from the CFIR through coding and categorisation. The transcripts were coded in MAXQDA Analytics Pro Software 2020 using the codebook developed. During the coding process, the emerging themes were linked to four domains of CFIR.

6.4 Results

Characteristics of Participants

Table 17 summarises the total number of participants recruited from the randomly selected three (Northern, Eastern and Central) regions. We conducted 17 IDIs with TB/HIV coordinators from these three regions. Additionally, we conducted eight FGDs with HIV care providers from eight IHV clinics, respectively. A total of 65 HIV healthcare providers participated in the eight FGDs.

Table 17:Total number of enrolled participants from the Northern, Central and Eastern regions

Participants	Type of data collection	Savannah Zone	Forest Zone	Coastal Zone	Total
Regional TB/HIV coordinators	In-depth interview (IDI)	0	1	1	2
District TB/HIV coordinators	In-depth interview (IDI)	1	2	3	6
Facility TB/HIV coordinators	In-depth interview (IDI)	2	4	3	9
HIV care providers	Focus group discussion (FGD)	2	3	3	8
HIV care providers	Number of participants for the FGD	14	29	22	65

Table 18 displays the background characteristics of the participants involved in the study. Out of the 17 IDIs conducted, 2 (12%) were regional, 6 (35%) were district, and 9 (52%) were facility TB/HIV coordinators, respectively. Most of the TB/HIV coordinators who participated in the IDI were males (n=11, 65%), while 6 (35%) were females. They age from 27 to 59 years old. And have worked for between 2 to 20 years, with over 82% having tertiary, while about 17% post-secondary non-tertiary education level. On the other hand, out of the 65 FGD participants, 39 (60%) were females, and their ages ranged from 24 to 59 years old. Most of them were clinicians (nurses) and had worked in an HIV clinic for between 1 to 15 years. Among the FGD participants, about 55% had attained tertiary, 39% had post-secondary non-tertiary, and 6% had upper secondary level of education.

Table 18: Background characteristics of study participants

Characteristics	**Number (%), median (range)**	
	FGD (n=65)	IDI (n=17)
Sex		
Female	39 (60.0)	6 (35.3)
Male	26 (40.0)	11 (64.7)
Age (median, range)	32 (24 – 59)	37 (27 - 59)
Level of education		

Upper secondary	25 (38.5)	0
Post-secondary non-tertiary	4 (6.1)	3 (17.6)
Tertiary	36 (55.4)	14 (82.4)
Profession		
Clinician	39 (60.0)	-
Non-clinician	26 (40.0)	-
Years working (median, range)	3 (1 – 15)	6 (2 – 20)

Factors influencing the implementation of TB screening among PLHIV

The themes emerging from our data were linked to the four domains of the CFIR (Table 19). The study has shown that barriers to TB screening include lack of commitment of health workers to screen HIV clients, limited or lack of privacy and space allocated for TB screening activities. Further, the enablers of TB screening relate to ease in TB screening, good communication, and networking between colleagues within the HIV clinic and within the facility. Other enablers included stakeholder engagements, good referral channels and health workers recognising the need for the intervention. These are described in detail in the following section.

Table 19: Emerging barriers and facilitators linked to CFIR domains

Domain	**Themes**	
	Facilitators	**Barriers**
Intervention characteristics	Ease of TB screening tool	Transport cost for sputum collection
	Goals setting, feedback and supervision	
Outer setting	Good referral relationships	
	Chemical sellers key in community case finding	
Inner setting	Renovations and innovations	Limited or lack of privacy and inadequate space to conduct TB screening

Individual characteristics	Acceptability of intervention among providers	Low commitment of care providers

Intervention Characteristic

In exploring the features of the intervention that might influence or impede the implementation of the TB screening intervention at the HIV clinic, our study found factors such as ease of the TB screening, and goal setting, feedback and supervision as facilitators. In addition, aside from the facilitators related to the intervention characteristics domain found, some barriers such as transport cost for sputum collected were identified. These facilitators and barriers found are presented below.

Ease of TB screening

Across our in-depth interviews and focus group discussions held, it was evident that the TB screening intervention was not challenging to implement. In exploring the complexity of TB screening, all the participants in the study stated that it was not complicated.

"…the screening itself is not complicated" – *FGD with HIV care providers group 7*

"The screening, for us, it is not complicated"- *IDI with Facility TB/HIV Coordinator 1*

"It is not complicated because if you take a good look at the screening tool it has all the questions you need to ask the client so it makes it easy" - *FGD with HIV care providers group 5*

Goals setting, feedback and supervision

National targets drive TB screening. However, the providers set facility-specific annual targets of cases to screen and detect from the interviews and discussions. Implementation of the intervention is monitored through monthly or quarterly reports from the providers to the district coordinators.

In addition to the reports, the coordinators embark on quarterly field visits. During such visits, the patients are interviewed to verify the implementation of the intervention. This was perceived as a facilitator to implementation.

> "We go on supportive supervision…There is also a database for reporting. Through that database, we are also able to monitor what they [providers] are doing, give feedback and discuss issues… When we go on monitoring and supervision we look at their data and interview some of the patients and they attest to the fact that they[patients] have been screened for TB and the data that they [providers] have also shown that they [providers] have been screening the patients for TB*"- IDI with Regional TB/HIV Coordinator 1*

District-level reports are prepared and sent to regional and national offices for dissemination and further decision making. There are also validations and peer reviews of reports. The care providers agreed that the feedback they receive "are helpful because you see where you have gotten to, and you see where your lapses are and where you have to put in more effort to improve." – *IDI with Clinic head*

Transport costs for sputum collected

The project's activities are decided and budgeted for at the national level. Therefore, the region or the district works with the budget line given them by the national program. The care providers stated that donors essentially bear the cost of TB screening. The main cost incurred by the providers is transportation costs for sputum transfer. This cost is seldom reimbursed, and, in many cases, the refunds are delayed. Therefore, the health workers bear the transportation cost.

> "When you screen somebody we have to take it to the lab and someone has to take transport to this place, if they have motor bicycle they have to fuel it. If the facility does not have motor bicycle then they have to pay for transportation. Some money comes for sputum transport but it is not enough as compared to the number of sputum that we have to pick from all the areas to the lab. So sometimes they incur so much money and what we do is that we place a book at the lab so anyone who brings samples to the hospital, they will write their names. So when money comes for

sputum transfer we just share it for them but the money is not enough" - *IDI with District TB/HIV Coordinator 4*

"The cost incurred includes the cost of transporting samples to the teaching hospital. We have to send samples to Cape Coast Teaching Hospital for culture "-*IDI with Facility TB/HIV Coordinator 1*

Outer setting

In exploring factors outside the HIV care hospitals, it emerged during our FGDs and IDIs that interactions with care providers in other facilities, referral relationships, and chemical sellers' roles were facilitators to the TB screening intervention, as discussed in detail below.

Referral relationships

The providers explained that their clinics relate with or network with their colleagues in other facilities who also implement TB screening intervention among PLHIV. The networks involve liaising with them, referring cases to them, discussing complex case management, sharing resources, and attending training and workshops. The care providers added that the relationship and collaboration between the districts and their respective facilities are excellent.

"We have the Genexpert. We are the only facility that has it in the whole Tamale Metropolis and they [other HIV clinics] all come to use it. They have our phone numbers. They call us as they come here to take their results from us … they come here, they bring their clients to us... we have a WhatsApp group so we are always in contact. So we have a network and the network is really strong and because we have each other's numbers, anytime there is a problem, it's easier for us to communicate and assist each other." – *IDI with facility TB/HIV Coordinator 9*

"With the HIV clinic we collaborate, when you come and you have HIV, we screen you for TB, you have TB we screen you for HIV, it is like our one-stop shop. We just do everything for you but if you have to be referred, you are referred" - *IDI with Facility TB/HIV Coordinator 7*

Licenced Chemical sellers key in community case finding

The technical policy and guideline for TB/HIV collaboration encourages all stakeholders working at the community level to include TB and HIV services and activities in their services. The district-level coordinators added from the interview that Licenced Chemical Sellers (LCS, over-the-counter medicine sellers) were essential stakeholders because they are the first point of call within the communities. LCS are the first point of care, especially when people experience mild symptoms of illness. Their main role as stakeholders is to refer people who they screen and have any sign or symptoms of TB to an HIV or TB clinics. During our interviews, our participants confirmed the role of these chemical sellers in TB case finding in the communities.

> A coordinator stated that "when somebody is coughing, the first point of call will be the chemical seller to get some medication. So we work with them, from time to time we meet them and we discuss how they can link those cases to us so that together we help the patients" – *IDI with district TB/HIV Coordinator 4*
>
> "The chemical sellers...because that is the first point of call, they are very important to case finding and screening so we always engage them."- *IDI with district TB/HIV Coordinator 2*

Characteristics of individuals

The characteristics of the individuals involved in the implementation were explored to identify their influence on the conduct of the TB screening intervention. As presented below, we found the acceptability of TB screening intervention among providers as facilitators and lack of commitment of care providers as a barrier that influences the implementation.

Acceptability of intervention among providers

The intervention is also widely accepted among care providers. In all the facilities involved in the study, the providers acknowledge the need for TB screening among PLHIV. They added that the intervention is good and advantageous to PLHIV. Therefore, the intervention is important and needful because it will help in the early detection and treatment of new cases.

> "…HIV clients are prone to get TB…so there's a need to screen them to know their status." – *IDI with facility TB/HIV Coordinator 6*

> "Yes, there is the need because every person living with HIV must be tested for TB because if they are tested and they are active or positive, they can be put on drugs so that they are treated or they are cured on the TB" – *FGD with HIV care providers Group 8*

Low commitment of care providers

Although generally, the health workers have accepted the need and relevance of the intervention, some health workers' attitudes towards the intervention were perceived as a barrier to implementation. Health workers carry out TB screening; therefore, their commitment or otherwise will directly affect the success of the intervention. Our participants alluded to the fact that a major problem is the willingness of some care providers to implement the intervention.

> "I think it's the human factor. The will to want to implement the tool is the problem… but it's the commitment."- *IDI with Facility TB/HIV Coordinator 9*

> "The steps are not cumbersome but then, it is the support that is not coming from the facility level, you only ask for cough, that is the cardinal sign but then the commitment is not there on behalf of the health workers"- *IDI with Regional TB/HIV Coordinator 2*

> "Screening is not anything difficult but I think, because of the infectious nature of TB, most of the people don't want to involve themselves in it"- *IDI with District TB/HIIV Coordinator 3*

Inner setting

The participants highlighted internal factors such as space, privacy, renovations and innovations as key determinants to TB screening. These infrastructural and structural changes within the HIV care clinics are further elaborated on below.

Privacy and space

According to the participants, lack of privacy and inadequate space at the TB/HIV care units within the hospitals/clinics is a potential barrier to TB screening. Congested spaces allocated to TB screening also pose a threat to the providers' health. Other providers mentioned that they did not have a laboratory for their collected samples. They added that these issues hindered the smooth implementation of TB screening for PLHIV. For example, during a focus group discussion, it emerged that "privacy is a paramount problem in our unit, the place is always choked." – *FGD with HIV care providers Group 9*

> "The unit we have for both TB and HIV clients is very small because both of them come to the same place on the same days for medication, screening and other activities… the place is even congested, their confidentiality is at stake" - *FGD with HIV Care providers group 3*

Renovations and innovations

The providers also reported that there had been changes in some health facilities to enable TB screening activities among PLHIV. These changes included creating additional rooms for TB/HIV activities, introducing new HIV registers, electronically capturing patients' data, and acquiring other screening equipment. The providers also explained that these alterations help in implementing the intervention.

> "…there is a new HIV register. Unlike the former one where it was not clearly [stated] in it, it was not enforced whether the HIV client has been screened for TB unless in the folder but this time around, in the folder, in the register, [and] on the e-tracker, it demands that.
> And that will encourage, it will push service providers to pay more attention to TB screening..." – *IDI with TB/HIV Coordinator 3*

"…introduction of the screening tool is helping the work… the x-ray is also helping with the screening and at the lab we have the gene expect that is also helping to detect cases, so policy-wise I think that is where the nation is now, trying to use the best of equipment to get the best of result." – *FGD with HIV care providers Group 6*

6.5 Discussion

The ultimate goal of TB case-finding and treatment is to cure the individual who has the disease, decrease its spread to other persons, mitigate death and avert disease-associated disability. Therefore, when cases are unidentified, treatment initiation is impossible. Not treating infected persons and noncompliance to TB treatment exposes the treatment cascade to failure, relapse and drug resistance with its associated complications [40]. The current study is critical as it reveals the existing factors (barriers and enablers) implementing TB screening among PLHIV in Ghana.

The emerging barriers and facilitators fall under the four domains explored in the study. Barriers to TB screening emerged from individual characteristics (i.e. low commitment of health workers) and inner setting (i.e. facility space and privacy allocated for screening activities). Facilitators of TB screening (emerging from all four domains) include (1) ease in TB screening, (2) good communication and referral channels, (3) effective goals and feedback mechanisms, (4) health workers recognising the need for the intervention and (5) the role of chemical sellers.

In this study, the commitment of health workers towards the intervention is a barrier to implementation. In clinics where the workforce is lax and partially involved in the screening process, the outcome of the intervention is also affected. Low commitment of health workers towards TB control practices was cited by Tamir et al. (2016) as a barrier to achieving outcomes. This was purported to have been caused by many health workers' lack of motivation and interest in the intervention. Also, the health workers not being reimbursed for going the extra mile to transport sputum samples out-of-pocket affects the sustainability of implementing TB screening among PLHIV.

Given that one of the facilitators for TB screening was recognising the need for the intervention incentivising health workers for incidental costs incurred and continuous engagement with them through training workshops [41] is plausible to drive commitment towards effective implementation. Cost is a primary driver of sustainability. Therefore, a broader dialogue on the cost of TB screening and its accompanying resources is needed, especially in this era of a global Covid-19 pandemic. Resource limitations re-directed and limited donor aids will leave some interventions strained, and TB is no exception. Tamir et al. (2016) also noted that renovations and other structural changes were not done due to financial constraints [42].

Quite relative to the involvement of health workers is the risk associated with screening, sputum collection and care of TB patients in congested spaces [42]. The staff-patient ratio aggravates the situation in these HIV clinics, where space and privacy are compromised because of resource constraints. In similar studies in Nigeria and China, the health workers adopted ways to keep their consulting and treatment areas well ventilated to control the spread of TB. Some health workers expressed concern over their health and safety, considering TB's contagious [43,44]. Addressing issues of space will boost the commitment and implementation drive for TB screening activities [45]

Our study also revealed that TB screening and case finding cascade includes informal players such as chemical sellers. As noted above, chemical sellers are stakeholders in Ghana's health system and mediate social behaviours of health [46]. This group of 'treatment outlets' offer treatment options to TB patients and help mainstream health workers detect cases. Therefore, there is a need to constantly engage and liaise with the chemical sellers to effectively implement TB screening through active case finding [47]. Networking and communication among health workers through sharing testing equipment and social media platforms like WhatsApp have offered collaboration opportunities for TB screening and case detection. The TB treatment chain has equally been strengthened through these internal and external support structures that the health system has. This provides an opportunity for driving implementation using these facilitators. Overall, the implementers noted that the TB screening intervention among PLHIV attending HIV clinics was important and necessary in reducing or decreasing the burden of TB in HIV clients in Ghana.

Strength and limitation

Our study is the first to document the factors that influence the implementation of TB screening among HIV clients in Ghana. Also, a fundamental implementation outcome – fidelity – is unpacked from an implementer's perspective to shed light on inherent, latent and apparent factors that determine the extent to which the TB screening intervention is carried out in HIV clinics in Ghana. Our study also utilised a combination of robust implementation frameworks to explore TB screening in Ghana holistically. This has allowed for an unconventional approach to identifying implementation bottlenecks and advantages that researchers, implementers, and policymakers can leverage to reach Ghana's optimum TB care targets.

The main limitation of our study is that only seven providers participated in some of the FGD, which violates the minimum number required for an FGD. Nonetheless, we found energetic interactions among participants in such discussions, which led to stimulations and providing first-hand information and new ideas from the HIV healthcare providers.

6.6 Conclusion

Our study presents critical points for the TB/HIV community despite the above limitations. First, our work shows that although there are barriers to implementing TB screening among PLHIV in HIV clinics in Ghana, the enablers or facilitators would contribute to case identification and eventually treatment of TB among PLHIV. Second, there is evidence of an overall recognition of the need for the intervention. Third, there is also a need to: (1) strengthen commitment of health workers; (2) address space constraints at the HIV clinics (3) deliberately and constantly engage other influential stakeholders such as chemical sellers and (3) explore sustainable ways for caring for this vulnerable population beyond donor support, especially during the Covid-19 pandemic when economies are under pressure to thrive, and foreign aids are gradually diminishing or being re-directed. Finally, our study showed that there are more facilitators to leverage to achieve successful implementation and optimal coverage of TB screening among PLHIV in Ghana.

This study may also provide relevant insights to engage with Ghana Health Services in developing the intervention to ensure outcomes from this study are utilised.

References

1. Ansa GA, Walley JD, Siddiqi K, Wei X. Assessing the impact of TB/HIV services integration on TB treatment outcomes and their relevance in TB/HIV monitoring in Ghana. Infect Dis Poverty. 2012;1(1):1.

2. Biermann O, Tran PB, Forse RJ, Vo LNQ, Codlin AJ, Viney K, et al. Capitalising on facilitators and addressing barriers when implementing active tuberculosis case-finding in six districts of Ho Chi Minh City, Vietnam: a qualitative study with key stakeholders. Implement Sci. 2021;16(1):1–12.

3. The Global Fund. Best Practices on TB Case Finding and Treatment Reflections and Lessons from West and Central Africa and Beyond. 2018.

4. The Global Fund. Assessment and Best Practices of Joint TB and HIV Applications Progress, Challenges, and Way Forward itle). Geneva, Switzerland; 2019.

5. World Health Organisation. TB Treatment and care. 2019.

6. Kanabus A. Information about Tuberculosis [Internet]. GHE. 2020 [cited 2020 Aug 28]. p. www.tbfacts.org. Available from: https://tbfacts.org/tb-statistics/

7. World Health Organization W. GLOBAL TUBERCULOSIS REPORT 2018. 2018.

8. Pawlowski A, Jansson M, Sköld M, Rottenberg ME, Källenius G. Tuberculosis and HIV Co-Infection. Hobman TC, editor. PLoS Pathog. 2012 Feb 16;8(2):e1002464.

9. WHO. Global TB Report 2017. 2018.

10. Dusenbury L, Brannigan R, Hansen WB, Walsh J, Falco M, Ghana NACP, et al. Quality of implementation: developing measures crucial to understanding the diffusion of preventive interventions. Who. 2014 1 June;15(1):1–9.

11. Saunders MJ, Tovar MA, Collier D, Baldwin MR, Montoya R, Valencia TR, et al. Active and passive case-finding in tuberculosis-affected households in Peru: a 10-year prospective cohort study. Lancet Infect Dis. 2019 1 May;19(5):519–28.

12. Getahun H, Van Gorkom J, Harries A, Harrington M, Nunn P, Perriens J, et al. INTERIM

POLICY ON COLLABORATIVE TB/HIV ACTIVITIES. TB/HIV Research

FoundationRegional Office for Africa South Africa). Paul Nunn Paul Pronyk; 2004.

13. WHO. WHO policy on collaborative TB/HIV activities Guidelines for national programmes and other stakeholders. 2012.

14. Owiti P, Onyango D, Momanyi R, Harries AD. Screening and testing for tuberculosis among the HIV-infected: Outcomes from a large HIV programme in western Kenya 11

Medical and Health Sciences 1117 Public Health and Health Services 11 Medical and

Health Sciences 1103 Clinical Sciences. BMC Public Health. 2019 8 January;19(1):29.

15. Adelman MW, McFarland DA, Tsegaye M, Aseffa A, Kempker RR, Blumberg HM. Costeffectiveness of WHO-Recommended Algorithms for TB Case Finding at Ethiopian HIV Clinics. Open Forum Infect Dis. 2018;5(1).

16. World Health Organization W. System screening for active tuberculosis: an operational guide. Geneva, Switz. 2015;(WHO/HTM/TB/2015.16).

17. Kranzer K, Houben RM, Glynn JR, Bekker LG, Wood R, Lawn SD. Yield of HIVassociated tuberculosis during intensified case finding in resource-limited settings: a systematic review and meta-analysis. Vol. 10, The Lancet Infectious Diseases. Elsevier; 2010. p. 93–102.

18. Dabaro D. Factors affecting tuberculosis case detection in Kersa District, South West Ethiopia. J Clin Tuberc Other Mycobact Dis. 2017 1 December;9:1–4.

19. Ghana Health Service. Implementation plan for IPT, Ghana [Internet]. 2017 [cited 2018 Jul 24]. Available from: https://www.google.co.za/search?q=IPT+for+TB+prevention+in+Ghana&oq=IPT+for+TB+prevention+in+Ghana&aqs=chrome..69i57.12706j1j8&sourceid=chrome&ie=UTF-8

20. World Health Organization W. Global Tuberculosis Control. 2009.

21. CDC. Ghana Country Profile [Internet]. 2019 [cited 2020 May 12]. Available from: https://www.cdc.gov/globalhivtb/where-we-work/region/westafrica/ghana/ghana.html

22. Getahun H, Kittikraisak W, Heilig CM, Corbett EL, Ayles H, Cain KP, et al.

Development of a Standardised Screening Rule for Tuberculosis in People Living with

HIV in Resource-Constrained Settings: Individual Participant Data Meta-analysis of Observational Studies. Murray M, editor. PLoS Med. 2011 Jan 18;8(1):e1000391.

23. World Health Organization. Treatment of tuberculosis: guidelines. 4th ed. Geneva, Switzerland: WHO/HTM/TB; 2009. 420 p.

24. Automated Real-time Nucleic Acid Amplification Technology for Rapid and Simultaneous Detection of Tuberculosis and Rifampicin Resistance: Xpert MTB/RIF System Policy Statement WHO Library Cataloguing-in-Publication Data Policy statement: automated real-time nucleic acid amplification technology for rapid and simultaneous detection of tuberculosis and rifampicin resistance: Xpert MTB/RIF system. 2011.

25. Programme GT. Automated real-time nucleic acid amplification technology for rapid and simultaneous detection of tuberculosis and rifampicin resistance: Xpert MTB/RIF assay for the diagnosis of pulmonary and extrapulmonary TB in adults and children. 2013.

26. World Health Organization. WHO | World Health Statistics 2015. WHO. 2016;

27. Falzon D, Schünemann HJ, Harausz E, González-Angulo L, Lienhardt C, Jaramillo E, et al. World Health Organization treatment guidelines for drug-resistant tuberculosis, 2016 update. Eur Respir J. 2017 Mar 1;49(3).

28. World Health Organisation. Guidelines for intensified tuberculosis case-finding and isoniazid preventive therapy for people living with HIV in resource-constrained settings.

Geneva; 2011.

29. Ghana Health Service. Implementation of TB/HIV collaborative activities in Ghana: Joint programme planning policy and guidelines. 2014.

30. Rediet Abebe, Mistre Fantahun, Yirgalem HaileMichael MY and MM. HIV Testing and Counseling among Patients with Tuberculosis at Arbaminch Hospital, Southern Ethiopia. Biomed Sci Technol. 2014;

31. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice : a consolidated framework for advancing implementation science. 2009;15:1–15.

32. Nilsen P, Bernhardsson S. Context matters in implementation science: A scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. Vol. 19, BMC Health Services Research. BioMed Central Ltd.; 2019. p. 189.

33. Safaeinili N, Brown-Johnson C, Shaw JG, Mahoney M, Winget M. CFIR simplified: Pragmatic application of and adaptations to the Consolidated Framework for Implementation Research (CFIR) for evaluation of a patient-centered care transformation within a learning health system. Learn Heal Syst. 2020 26 January;4(1).

34. Keith RE, Crosson JC, O'Malley AS, Cromp D, Taylor EF. Using the Consolidated Framework for Implementation Research (CFIR) to produce actionable findings: a rapidcycle evaluation approach to improving implementation. Implement Sci. 2017 Dec 10;12(1):15.

35. VanDevanter N, Kumar P, Nguyen N, Nguyen L, Nguyen T, Stillman F, et al. Application of the Consolidated Framework for Implementation Research to assess factors that may influence implementation of tobacco use treatment guidelines in the Viet Nam public health care delivery system. Implement Sci. 2017 Dec 28;12(1):27.

36. O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. Standards for reporting qualitative research: A synthesis of recommendations. Acad Med. 2014;89(9):1245–51.

37. Narh-Bana SA, Kawonga M, Chirwa, Esnat D LI, Bonsu F, Chirwa TF. Fidelity of implementation of TB screening guidelines by health providers at selected HIV clinics in Ghana. 2021;(135):1–21.

38. Narh-Bana SA, Chirwa TF, Chirwa ED, Bonsu F, Ibisomi L, Kawonga M. Adherence of HIV clinics to guidelines for the delivery of TB screening among people living with HIV / AIDS in Ghana. 2021;9:1–13.

39. Gale, Nicola K; Heath, Gemma; Rashid, Sabina; Redwood S. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. BMC Med Res Methodol. 2013;13(117):260–1.

40. Osei E, Oppong S, Adanfo D, Doepe BA, Owusu A, Kupour AG, et al. Reflecting on tuberculosis case notification and treatment outcomes in the Volta region of Ghana: a retrospective pool analysis of a multicentre cohort from 2013 to 2017.

41. Getnet F, Hashi A, Mohamud S, Mowlid H, Klinkenberg E. Low contribution of health extension workers in identification of persons with presumptive pulmonary tuberculosis in Ethiopian Somali Region pastoralists. BMC Health Serv Res. 2017;17(1):1–9.

42. Tamir K, Wasie B, Azage M. Tuberculosis infection control practices and associated factors among health care workers in health centers of West Gojjam zone, Northwest Ethiopia: a cross-sectional study. BMC Heal Serv Res 2016 161. 2016 Aug;16(1):1–11.

43. He GX, Hof S van den, Werf MJ van der, Wang GJ, Ma SW, Zhao DY, et al. Infection control and the burden of tuberculosis infection and disease in health care workers in china: a cross-sectional study. BMC Infect Dis. 2010 Oct;10:313.

44. LU O, JN C, KA U, PG O, CD N. The status of tuberculosis infection control measures in health care facilities rendering joint TB/HIV services in "German Leprosy and Tuberculosis Relief Association" supported states in Nigeria. Niger J Clin Pract. 2011 Jul;14(3):270–5.

45. Ayakaka I, Ackerman S, Ggita JM, Kajubi P, Dowdy D, Haberer JE, et al. Identifying barriers to and facilitators of tuberculosis contact investigation in Kampala, Uganda: A behavioral approach. Implement Sci. 2017;12(1):1–13.

46. Bonsu F, Hanson-Nortey N, Afutu F, Dzata F, Ahiabu M, Chimzizi R, et al. The National Tuberculosis Health Sector Strategic Plan for Ghana 2015-2020. 2014.

47. Biermann O, Lönnroth K, Caws M, Viney K. Factors influencing active tuberculosis casefinding policy development and implementation: A scoping review. BMJ Open. 2019 Dec 11;9(12):e031284.

7.0 Combined facility-provider level Fidelity of implementation of the intervention

This chapter ends the result chapters. The fourth paper is presented in this chapter. The article has been submitted and is currently under review for publication (the original draft has been attached as Appendix D). The paper covers objectives 1 and 3 of the main study. This result chapter, similar to the earlier chapters, includes an abstract, introduction, methods, results, discussion, and conclusion sections with the list of references cited in the paper presented at the end of the chapter. It assesses combined implementation fidelity by combining the core activities of the HIV healthcare workers and the facilities for implementing the intervention at HIV clinics within district hospitals in Ghana. We compared the combined fidelity assessed to the fidelity at the provider and the facility levels.

7.1 Abstract

Background

Implementation outcome assessment such as fidelity is essential in implementing health intervention. Limited studies that have been conducted have assessed fidelity separately at the healthcare provider level or facility level with managers. However, there might be variations in facility resources and their utilization, skewing such comparisons. We, therefore, would like to investigate whether a combined provider-facility level fidelity is a more effective assessment. We aim to describe the weighted fidelity of implementing the guidelines for TB screening among PLHIV and examine its effect on TB screening coverage at selected HIV clinics in Ghana.

Methods

This was cross-sectional study and collected data from 226 HIV care providers and 27 managers of district hospitals implementing the TB screening intervention at the HIV clinics. We also extracted information from monthly TB registers for 2018. Weighted fidelity was measured based on the extent to which the intervention was implemented, considering both the facility and the provider level assessments. Response scores and data extracted on fidelity were analyzed and summarized using (1) the median and inter-quartile range for non-normal data

such as fidelity scores and coverage and (2) frequencies and percentages for categorical data such as resources availability.

Linear regressions models were fitted for TB screening coverage using the fidelities separately.

Results

The study revealed that the weighted fidelity median score was 67% (IQR: 59.9 – 74.9%), and the TB screening coverage was 71.3% (IQR: 56.9 – 96.7). Weighted fidelity of delivery was statistically associated with TB screening coverage ($p<0.01$). All the moderating factors investigated have no statistical association with weighted fidelity of delivery ($p>0.05$) except for IE&C. Facilities with TB IE&C materials available had a significantly ($p=0.025$) higher median fidelity score 75.4% (74.9 – 88.5) than their counterparts 65.7% (59.4 – 72.6).

Conclusions

The combined provider-facility level assessment of fidelity demonstrated that weighted fidelity of delivery is positively associated with TB screening coverage and provided a better platform for assessing implementation fidelity. It also showed that the availability of IE&C materials significantly moderates the weighted fidelity of delivery. Weighted fidelity is an efficient way of holistically assessing fidelity within health facilities.

Keywords Composite, weighted, fidelity of delivery, TB screening, facilities, Ghana

7.2 Introduction

Programme implementation is vital in achieving and strengthening desired health intervention results. Effective implementation of an intervention at a health facility requires combined multisectoral effort, i.e. it relies on both the facility managers, the health care providers or workers and facility resources for the intervention to improve health outcomes. A review of several health care interventions implemented within health facilities revealed that the programmers had provided guidelines for management and core implementers (health workers) to aid implementation [1,2]. For example, the policy guideline for conducting TB screening among PLHIV attending HIV clinics in Ghana contained specific guidelines and activities to be provided by the facility as a unit and another set of policies and activities to be delivered by the health worker for the intervention to be successfully implemented in the facility [3]. However, there exists little information on the extent of holistic implementation of the intervention.

Most studies assessed fidelity of delivery separately, either at the facility level or the provider level. However, there might be variations in facility resources which might skew the comparison. Though the provider level or facility level adherence or fidelity provides an important measure for identifying specific components for implementation improvement and tracking the progress, they fail to provide an easily accessible picture of the performance of the implementation [4] on an intervention outcome. According to the Institute of Medicine (IOM) [5], combined measures are an aggregation of individual performance measures into a summary score, thereby reducing the amount of data to be processed, leading to a clearer picture of overall fidelity. It serves multiple purposes, including the "provision of a summary of the extent to which management has created a "culture of excellence" and designed processes to ensure high performance in delivering services throughout the organization, benchmarking of organization's performance against high-performing organizations and to monitor changes over time, tracking a particular components' performance, providing performance criteria to use in selecting high-performing facility, and for identifying high-performing facilities which can then be studied to identify characteristics that distinguish them from lower-performing facilities" [4].

Implementation science research assessments of health interventions revealed that interventions are mostly not delivered as designed by the intervention's designers. This is referred to as implementation fidelity or adherence to the delivery [6–8]. As discussed earlier,

some of these studies assessed fidelity of delivery from either the health workers' perspective [9] or the facility (managers') perspective [10]. Weighted fidelity to combine both are lacking in the implementation science literature. The term weighted fidelity is used in this study as an umbrella to refer to the combination of whether the facility managers adhere to protocol guidelines of the implementing the TB screening intervention at the facility and whether the HIV healthcare provider adheres to the clinical guidelines and activities for delivering the intervention as is. Weighted fidelity, a composite measure, is essential to fully understand the extent of implementation to maximize the potential for effectiveness and relate to observed intervention outcomes.

Implementation fidelity (including 'weighted' fidelity) is a component of process evaluations [11,12], which documents whether the intervention activities have been delivered as intended and resulted in a separate output [12,13]. Process evaluation may be conducted periodically at any phase of the intervention evaluation [14] by reviewing the activities and output components to assist stakeholders in seeing how the intervention is performing. That is, the assessment can be done at the feasibility, effectiveness or implementation stages. Weighted fidelity of delivery is a complex mix of health providers' and facility managers' adherence. The TB screening activities from the providers' level will have to be aggregated at the facility level and combined with the facility managers' TB screening implementation activities. Studies have proposed and used different evaluation methods to fully understand the extent of the implementation [14]. Mixed methods evaluations had been proposed by some studies [15,16]. Other studies also proposed quantitative methods through observation and self-reporting [14], recording of sessions, transcription, and rating a random proportion against a checklist [8,17] to assess fidelity of delivery. Irrespective of all these approaches, multiple methods have been recommended to overcome the limitation of the individual methods [18–21]. They proposed that more consideration on the choice of method should be placed on the resources available for conducting the study and the context in which the study is to be undertaken. Quantitative approach through self-reported and record reviews work alternatively well when the research is resource-constrained, if stigmatization is an issue and observation is considered a paramount choice of method. This latter approach also provides in-depth understanding of the factors influencing fidelity [21] and is able to relate fidelity of delivery to intervention outcomes observed.

Fidelity of delivery occurs within the implementation process [11] to achieve intervention outcomes. The extent of full delivery of the intervention is also influenced by some factors

including availability of resources, health workers, workspace, etc. [22]. To take the complexities of the fidelity assessments and its related factors into account, a theory needs to include factors that potentially influence fidelity and the components for determining fidelity. Many frameworks to assess fidelity exist. One such integrated framework is the Conceptual Framework for Implementation Fidelity by Carroll et al. [23].

Carroll et al.'s [23] framework provides guidance to measure fidelity and its related factors. The framework proposed that the relationship between the implementation of evidence-based intervention and its outcome may be influenced by fidelity (the extent to which the intervention is delivered as is). They proposed further that "the measurement of implementation fidelity is the measurement of adherence, i.e., how far those responsible for delivering an intervention actually adhere to the intervention as its designers outline it. Adherence includes the sub-categories of content, frequency, duration and coverage (i.e., dose). The degree to which an intervention's intended content or frequency is implemented is the degree of implementation fidelity achieved for that intervention. The level achieved may be influenced or affected, (i.e., moderated) by certain other variables: intervention complexity, facilitation strategies, quality of delivery, and participant responsiveness". Finally, according to Carroll et al. [23], when the critical components of an intervention are identified and implemented well, then an implementation is said to be successful.
The framework provides a systematic method that can be used to assess fidelity and its related factors and has previously been used in different sectors of life [23,24]. However, to the best of the authors' knowledge, no research had ever assessed weighted fidelity of delivery. Therefore, this study extends previous research by using a systematic approach to advance initial strategies that could be used to improve fidelity assessment in the health sector.

The strategies outlined in this paper are to be well-thought-out within the context of TB screening among PLHIV attending HIV clinics in Ghana. TB screening is an early TB detection strategy aimed at decreasing the burden of TB in PLHIV and AIDS. The technical policy and guidelines for TB/HIV collaboration in Ghana spelt out various activities and guidance to pursue at multiple facilities. The TB screening intervention was to be carried out "as part of the health sector response to the intersecting TB and HIV epidemics (sector-wide approach – SWAP), and as part of the essential health care package (EHP) in Ghana" [3]. The intervention consisted of standard components delivered by the facility managers and components provided to all HIV clients by the HIV health worker. Details of the intervention components for the

managers are reported in the facility level fidelity paper [10], while that of the HIV care providers are reported in the provider level fidelity paper [9].

Utilizing the Conceptual Framework for Implementation Fidelity, this study aimed to demonstrate one way in which fidelity can universally be assessed to improve intervention outcomes. The paper specifically aimed to:

1. Assess weighted fidelity of delivery to the intervention
2. Identify factors influencing weighted fidelity of delivery, and
3. Relate the weighted fidelity scores with the respective TB screening coverage.

7.3 Methods

Setting of the study

Details of the study area are published elsewhere [9,10], but briefly, it was conducted in 27 district hospitals with functioning HIV clinics in Ghana. These hospitals are located across the length and breadth of the country.

Study design and participants

The study was cross-sectional and descriptive in design. It used a census-based approach with a structured questionnaire to conduct face-to-face interviews with the study participants in the selected district hospitals.

The district hospitals included in the study were identified as facilities having both geneXpert and X-ray machines as a requirement to have begun the initiation of IPT in TB confirmed negatives in HIV clients in 2017 [25]. Therefore, the participants were heads of the health facility (in the absence of the TB/HIV coordinator or the in-charge of the HIV clinic in interviewed) for the facility level and HIV care providers for the provider level. Successful intervention implementation requires the health facilities to deliver specific guidelines and activities to enable the HIV healthcare providers to implement the intervention among the PLHIV attending the HIV clinic.

Description of Intervention

The intervention assessed in this study is TB screening among PLHIV attending HIV clinics in Ghana. In 2004, based on the dual effect of TB and HIV on the individual and the nation, the WHO released a collaborative policy guideline for member countries with the challenge to adopt. Ghana recognized active TB case-finding as one of the best ways to decrease the burden of TB in PLHIV hence it adopted the WHO TB/HIV collaborative policy guidelines and implemented the intervention in 2007 [26]. The Ghana National Tuberculosis Control Programme (NTP) and the National HIV/AIDS Control Programme (NACP) designed the intervention [26]. The intervention aimed at reducing the burden of TB among PLHIV required TB screening for all HIV clients attending HIV clinics and initiating appropriate treatment. In addition, the guidelines spelt out explicit activities to be undertaken by the facility as an entity and other activities undertaken by HIV care providers.

In the policy guidelines [26], facilities are to ensure:

1. The facility regularly runs an HIV clinic daily except weekends
2. They conduct an intensive TB-case finding among PLHIV attending the HIV clinic
3. TB infection control at the facility
4. Review meetings are held regularly.

While HIV care providers are to ensure:

1. Every HIV client visiting the HIV clinic is screened for TB using the TB screening tools
2. TB awareness through education and counselling for all HIV clients attending HIV clinic

Interventionist

They included the facilities as an entity and the HIV healthcare providers working at the HIV clinic within the district hospitals. The designed guidelines and activities to be delivered by the facility managers to ensure the intervention is implemented within the facility is referred to as facility level. On the other hand, the designed clinical guidelines and activities for the intervention to be implemented by the healthcare providers is referred to as the provider level. Delivery of the guidelines and activities at the facility level is as important as delivering the intervention guidelines at the provider level.

Implementation measures

The core features of the programme guidelines and clinical guidelines were identified from the guideline with guidance from the CFIF. Two semi-structured questionnaires were developed specifically for the study based on the core features identified to measure the weighted fidelity of delivery. One of the questionnaires contained all the components for the facility level, while the other had all the components for the provider level.

The key components of the programme guidelines of the intervention to be delivered at the facility level were identified and operationalized. The component covered content, frequency, and coverage constructs that Carroll et al. (2017) identified in their CFIF. Questions were measured differently. Some were measured either as 1=yes, activity performed, 0=no, an activity not performed, others measured on a scale of 1 to 3 (1=not adherent, 2= partially adherent and 3= fully adherent). Others were measured with a 3-Likert scale where 1=one day a week, 2=2-4 days a week and 3=every day of the working days. Others were measured on a 5-Likert scale (1=annually, 2=half yearly/bi-annually, 3=quarterly, 4= monthly, 5=weekly).

The key components in the clinical guidelines for the providers to deliver the intervention were also identified and grouped under content and frequency constructs in the CFIF. Most of the factors were measured similar to the programme factors. Other factors were measured on a scale of 1 to 4, with 4 being the highest response.

Data Sources

We conducted a face-to-face interview with facility managers on how the facility level components were delivered and with HIV healthcare providers on the extent of delivery of the activities at the provider level. In addition, we extracted data from the HIV and TB registers to assess TB screening coverage and workload.

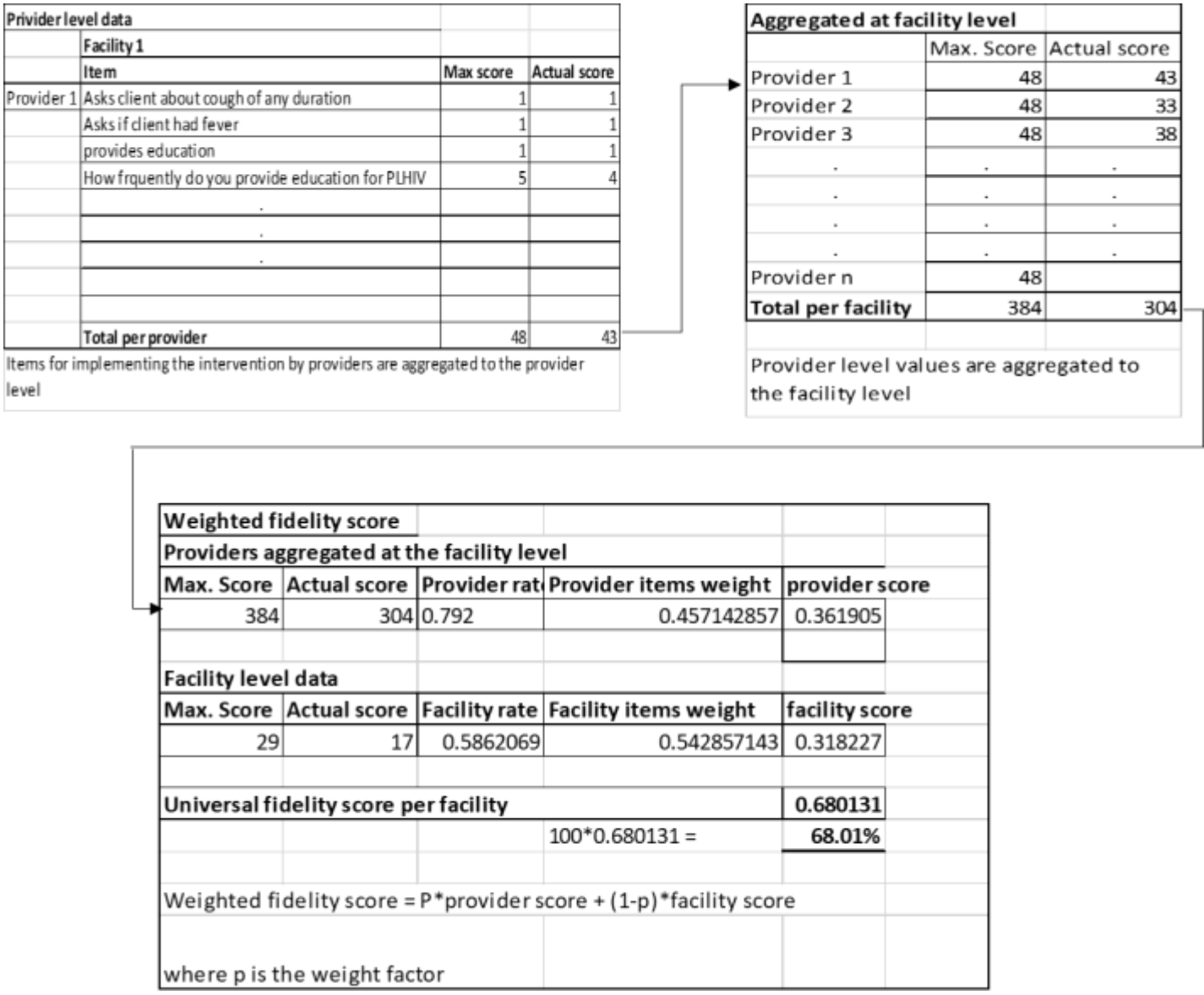
Statistical analysis

Assessing a weighted fidelity as a combined measure of provider level and facility level items requires a valid and reliable approach by which measurement data may be aggregated and used to provide information of facility performance based on a single quality score.

The Premier, Inc. and the Centers for Medicare and Medicaid Services (CMS) launched the Hospital Quality Incentive Demonstration Project (HQI) to measure facility performance and pay incentives to top-performing participating hospitals.

We modified the CMS HQI Demonstration Composite Quality Score Methodology by incorporating TB screening guidelines as items to calculate our weighted fidelity score for each participating facility. The TB screening Weighted Fidelity Score is comprised of two separate components: a provider level items response scores and a facility level items response scores. Figure 15 illustrates the steps in calculating the weighted fidelity score for one health facility. First, we accounted for the relative contribution of the number of items for each component by applying proportional weighting values. For instance, the provider level components account for sixteen of the items, therefor a weight factor of 0.457 (16/35) is used. Similarly, the facility level component is weighted 0.523 (19/35). Next, the weighted fidelity score was calculated after the weights were applied to the components using the formula below:

Weighted fidelity score = **p***composite provider level fidelity score + **(1-p)***composite facility level fidelity score, where p is the weight factor.



Privider level data			
	Facility 1		
	Item	Max score	Actual score
Provider 1	Asks client about cough of any duration	1	1
	Asks if client had fever	1	1
	provides education	1	1
	How frquently do you provide education for PLHIV	5	4
	.		
	.		
	.		
	Total per provider	48	43

Items for implementing the intervention by providers are aggregated to the provider level

Aggregated at facility level		
	Max. Score	Actual score
Provider 1	48	43
Provider 2	48	33
Provider 3	48	38
.	.	.
.	.	.
.	.	.
.	.	.
Provider n	48	
Total per facility	384	304

Provider level values are aggregated to the facility level

Weighted fidelity score				
Providers aggregated at the facility level				
Max. Score	Actual score	Provider rat	Provider items weight	provider score
384	304	0.792	0.457142857	0.361905
Facility level data				
Max. Score	Actual score	Facility rate	Facility items weight	facility score
29	17	0.5862069	0.542857143	0.318227
Universal fidelity score per facility				0.680131
			100*0.680131 =	68.01%
Weighted fidelity score = P*provider score + (1-p)*facility score				
where p is the weight factor				

Figure 15: Sample weighted implementation fidelity score calculation for one health facility

Median with interquartile range (IQR) was presented for continuous variables and frequencies with percentages for categorical variables. In addition, the frequency distribution of the facilities' background factors, the distribution of fidelity scores by facility, and the overall weighted fidelity were reported. Having calculated the fidelity scores and establishing non-normality of the outcome variable (fidelity scores), Mann-Whitney test, Kruskal-Wallis test and Spearman's correlation coefficient were used to compare scores across facility factors.

Finally, we examined the value of the combined fidelity by fitting and comparing three models with TB screening coverage as an outcome. Each model separately included either the provider

or facility or the combined fidelity adjusting for the facility level factors assessed in this study, including ecological zone, availability of TB screening tools, TB/HIV clinical manual, screening guideline, workload etc. The R-squared, adjusted R-squared, Root Mean Square Error (RMSE), F-test and the p-value associated with the t-stats were presented. All analyses were performed in STATA version 15 at a 5% significance level.

7.4 Results

Table 20 presents the frequency distribution of background factors of the 27 participating health facilities. Geographically, 7 (26%) of the HIV clinics were located in the Savannah zone, 11 (41%) in the Forest zone, and 9 (33%) in the Coastal Zone. The study showed that most facilities have the resources and materials required for conducting the TB screening. For instance, 20 (74%), 23 (85%), 21 (78%), 40 (89%), and 23 (85%) have TB screening tool, TB/HIV clinical manual, TB screening guidelines, TB IE&C materials, and TB prevention and infection control guideline available in the facility respectively.

Table 20: Distribution of background factors of the selected HIV clinics

Variable	Value	Frequency (%)
Ecological zone	Savannah	7 (26)
	Forest	11 (41)
	Coastal	9 (33)
TB screening tool available	Yes	20 (74.1)
	No	7 (25.9)
TB/HIV clinical manual available	Yes	23 (85.2)
	No	4 (14.8)
TB screening guideline available	Yes	21 (77.8)
	No	6 (22.2)
TB IE&C materials available	Yes	24 (88.9)
	No	3 (11.1)
TB prevention and infection control guideline available	Yes	23 (85.2)
	No	4 (14.8)
Number of HIV healthcare providers per HIV clinic	Median (IQR)	9 (8 – 10)
Number of PLHIV attending the HIV clinic per month	Median (IQR)	609 (182 – 1479)
Number of PLHIV screened for TB per month	Median (IQR)	352 (112 – 1479)

Number of patients per provider per month	Median (IQR)	66.7 (18.3 – 127.9)

The study also found that the median number of HIV care providers per HIV clinic was 9 (IQR: 8 – 10), while the median number of patients per provider per month was 66.7 (IQR: 18.3 – 127.9).

In order to conduct further analysis, reliability checks were carried out to examine the validity and reliability of the instruments used. To do this, we used Chronbach's Alpha to examine the provider level construct, and the facility level construct. Our finding showed that all the Alpha values of the constructs examined were greater than the recommended value [27]

Fidelity scores and related factors of the weighted fidelity score

Table 21 presents the fidelity score from the separate level and the facility factors associated with the weighted fidelity score. The fidelity scores for the facility and healthcare providers were assessed separately and the weighted fidelity score. At the provider level, we found the median fidelity score to be 79% (IQR: 58.3, 100.0), with some providers scoring 16% and others scoring as high as 100%. While at the facility level, the median fidelity score was 62.1% (IQR: 58.6 – 65.1), ranging from 48.3% to 82.8%. On the other hand, we found that the median of the weighted fidelity score was 67% (IQR: 59.9 – 74.9%).

Table 21: Distribution of weighted fidelity scores by facility characteristics

Variable	Value	Weighted fidelity score Median (IQR)	*p* value
Ecological zone	Savannah	74.7 (63.7 – 76.4)	0.417
	Forest	66.0 (56.3 – 70.5)	
	Coastal	65.3 (59.9 – 74.9)	
TB screening tool available	Yes	67.2 (56.3 – 74.9)	0.740
	No	66.4 (62.7 – 75.4)	
TB/HIV clinical manual available	Yes	75.6 (69.3 – 82.4)	0.101
	No	66.0 (58.9 – 73.5)	
TB screening guideline available	Yes	66.8 (63.7 – 74.9)	0.448
	No	63.0 (56.3 – 71.7)	
TB IE&C materials available	Yes	75.4 (74.9 – 88.5)	**0.025**
	No	65.7 (59.4 – 72.6)	
TB prevention and infection control guideline available	Yes	75.6 (69.3 – 82.4)	0.101
	No	66.0 (58.9 – 73.5)	
Number of HIV healthcare providers per HIV clinic		66.7 (59.9 74.9)	0.687
Number of PLHIV attending the HIV clinic per month		66.8 (59.9 – 74.9)	0.862

Number of PLHIV screened for TB per month		66.8 (59.9 – 74.9)	0.490
Number of patients per provider per month		66.8 (59.9 – 74.9)	0.869
		Median score (IQR)	
Screening coverage		71.3 (56.8 – 96.7)	-
Facility fidelity		62.1% (IQR: 58.6 – 65.1)	-
Provider fidelity		79% (IQR: 58.3, 100.0)	-
Weighted fidelity	-	66.8 (59.9 – 74.9)	-

In terms of facility factors associated with weighted fidelity, Table 21 shows a statistically significant difference in the median weighted fidelity scores by the availability of TB IE&C materials in the facility. Facilities with TB IE&C materials available had significantly (p=0.025) higher median weighed fidelity score (75.4% (74.9 – 88.5)) than their counterparts (65.7 (59.4 – 72.6)). The rest of the factors, including the ecological location of the facility, availability of TB screening tools, and the number of clients seen at the HIV clinic per month, do not show statistically significant differences in the median weighted fidelity scores. See Table 18.

Comparing the fit of the three different fidelity models

Three independent models were fitted for the TB screening coverage using the separate fidelities (provider, facility and weighted) as the main indicator controlling for the facility level factors assessed in this study. The statistics for evaluating the fit of the different regression models are presented in Table 19. The provider and the weighted fidelities were are significant predictors of TB screening coverage ($p<0.05$), but facility fidelity was not ($p>0.05$). The study shows from the calculated R-squared that 56.8%, 80.4%, and 86.8% of the variance in the TB screening coverage can be explained by facility, provider, and weighted fidelities, respectively. Also, from the adjusted R-squared, the models indicated that about 77.1% of the TB screening coverage was explained by the weighted fidelity model followed by 66.1% by the provider fidelity model and then 25.1% by the facility fidelity model after adjusting for the factors in the model. Table 12 further showed that the weighted fidelity ($p<0.001$) models provider fidelity ($p<0.001$) model were highly statistically significant while the facility fidelity ($p=0.1457$) model was not statistically significant.

Table 22: Model statistics assessing the fidelity type in relation to screening coverage

Model (Fidelity type)	P-value	R-Squared	Adjusted R-Squared	P-value (Ftest)	RMSE
Provider	0.000	0.8045	0.6611	0.0013	11.552
Facility	0.085	0.5677	0.2507	0.1457	11.178
Weighted	0.000	0.8680	0.7712	0.0001	9.4915

RMSE=Root Mean Square Error. The models were adjusted using facility-level factors assessed.

Weighted fidelity score and coverage HIV clinics

The study found that the median score for the TB screening coverage was 71.3% (IQR: 56.9 – 96.7). The minimum coverage was 41.3% for some facilities, while some other facilities scored the maximum of 100%. Figure 16 displays a comparison between weighted fidelity score and TB screening coverage from the selected HIV clinics implementing the TB screening intervention among PLHIV. The study further showed that high weighted fidelity scores were associated with much higher TB screening coverage and vice versa. For instance, facilities with a weighted fidelity score of 66.8% or 81.6% had TB screening coverage of 78.4% or 91.0%, respectively. Also, facilities with a weighted fidelity score of 51.1% or 60.0% ascertained TB screening coverage of 41.3% or 43.7%. A very high statistical association between the weighted fidelity score and TB screening coverage was therefore observed ($p<0.01$) in our study.

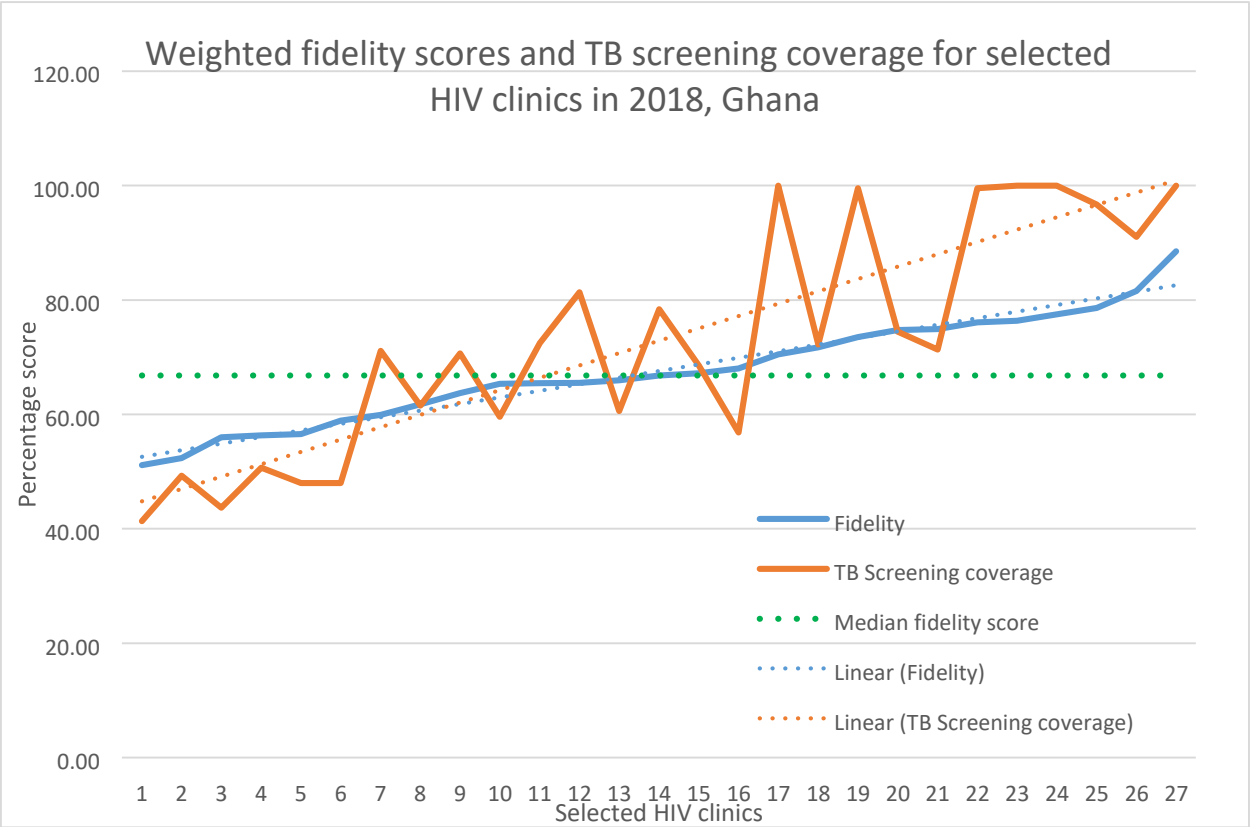


Figure 16: Weighted fidelity score and TB screening coverage in selected HIV clinics in Ghana

7.5 Discussion

Weighted fidelity as a composite measure aggregates performance measures from different levels within a system into summary scores, minimizes voluminous data and produces a clearer, easily accessible and understandable overview of the overall performance of the implementation process. The observed results of the study have provided support for the validity of the instruments developed and the combined analysis adopted to examine the weighted fidelity of delivery of the TB screening intervention. The reliability of the provider level constructs and the facility level constructs were confirmed through the well-known and accepted statistical test, Cronbach Alpha, and all the Alpha values exceeded the recommended values in the literature [27–29]

In this study of 27 selected district hospitals and 226 HIV healthcare providers screening for TB among PLHIV attending the HIV clinics within the district hospitals, we characterized all facilities using provider-level and facility-level data to generate a weighted fidelity score. The

weighted fidelity score is a composite score of the two levels. We conducted a weighted fidelity analysis using these composite scores and found that about 51% of the health facilities had their weighted fidelity scores above the median score. These data present further evidence that characterizing all facilities using a construct that classifies facilities as high or low weighted fidelity may be a helpful framework for categorizing facilities in terms of fidelity or adherence levels. Besides, in the separate analysis, the median fidelity score at the facility level was 62%, and the provider level was 79% compared to the median weighted fidelity score of 67%. After examining the fit and significance of the three models, we observed that the weighted fidelity model provides a better platform for assessing fidelity of delivery than the separate fidelities, especially the facility level. This was clearly shown by the R-squared values calculated in this study. In addition, the separate fidelities scores observed provided information on the extent of adherence at those specific levels. In comparison, the combined provided an overall picture of the extent of adherence to all the critical activities related to the implementation of the intervention.

The results of this study have provided support that weighted fidelity assessment is an important factor in assessing the extent to which an intervention is being implemented. The results indicated that provider, facility and weighted fidelity scores significantly and positively relate to TB screening coverage. Overall, weighted fidelity relates more strongly to the outcome than provider fidelities and facility. As the fidelity of delivery was very low, TB screening coverage in the intervention outcome was much lower. The study showed that, once fidelity is very high, an intervention is assured of achieving its desired result. This finding agrees with what Durlak and DuPre 2008 [30] found in the meta-analysis, which suggested that well-implemented interventions achieved more outstanding intervention outcomes than poorly implemented interventions. Many other implementation research projects have concluded similarly [23,31–33].

Surprisingly, the results obtained from this study demonstrated that only the availability of information education and communication (IE&C) materials and resources at the intervention site (HIV clinics) were found to influence weighted fidelity score significantly. That is, facilities with IE&C available had a higher weighted fidelity score than those who do not have those resources.

IE&C materials in an intervention help bring the understanding, awareness, provide information, and eradicate mythical beliefs of implementing an intervention [34]. However, most of the moderating factors assessed, including the availability of TB screening tool,

TB/HIV clinical manual, and TB prevention and infection control guideline, the number of HIV healthcare providers per HIV clinic, the number of PLHIV attending the HIV clinic per month, and staff workload did not significantly influence weighted fidelity of delivery in this study. Although there were no discernible differences in the weighted fidelity levels between the three zones due to limited sample size, the Savannah zone had the highest median weighted fidelity score compared to Forest and Coastal zones that had an almost similar median score.

Contrary to the findings on moderating factors, in a separate analysis conducted at the facility level [10], resources such as availability of TB screening questionnaire and TB screening guidelines, and health facility utilization factors such as number of PLHIV attending HIV clinic per month and number of patients per provider per month significantly influence facility-level fidelity.

Limitation

Our findings should be considered with caution and may not be generalized. The number of health facilities involved in the study was too small, resulting in difficulties in conducting and interpreting results from some statistical tests with confidence. For instance, the unit of our analysis was the facility level which consisted of 27 facilities.

In addition to the small sample size possibly affecting our analysis, our study did not address the provider level moderating factors. Therefore, we cannot comment on whether any factor related to the provider influences the weighted fidelity of delivery.

Different weighing methods might require an understanding of the practical implications of the items to indicate how important they are in the construct. Some weighting approaches may introduce additional biases into the dataset if care is not taken. Hence, the weighting approach adopted for this study was appropriate and ensured the different levels of data were considered at an equal proportion. Also, the combined fidelity measure for each facility from the provider and facility perspective will aid internal facility fidelity improvement. Notwithstanding, we suspect that composite measures have identified some facilities as obtaining high weighted fidelity scores because those facilities were doing "reasonably well" across most of the component measures but not "well enough" to be high performers on those measures. More research to examine this hypothesis in future will be useful.

7.6 Conclusions

We conducted an implementation science study to assess fidelity by combining the components from the provider and facility levels. The study also aimed to understand the influence of facility level moderating factors on weighted fidelity of delivering TB screening intervention among PLHIV attending HIV clinics in Ghana. The results indicated that weighted fidelity of delivery is an important factor and provides a better platform for assessing the implementations fidelity of the TB screening intervention among HIV clients. In addition, we found a positive linear relationship between weighted fidelity score and TB screening coverage. However, most of the moderating factors examined did not significantly influence the weighted fidelity of delivering the TB screening intervention among HIV clients, except IE&C. These results should be treated with caution due to limitations outlined earlier. Therefore, future studies should take into consideration these limitations.

References

1. WHO. WHO policy on collaborative TB/HIV activities Guidelines for national programmes and other stakeholders. 2012.
2. World Health Organization W. WHO | WHO Three' I's meeting: intensified case finding, isoniazid preventive therapy and TB infection control for people living with HIV. WHO. 2015;
3. Ghana Health Service. Implementation of TB/HIV Collaborative Activities in Ghana : Joint Programme Planning Policy and Guidelines Implementation of TB/HIV Collaborative Activities in Ghana Joint Programme Planning Policy and Guidelines. Accra; 2014.
4. Shwartz M, Restuccia JD, Rosen AK. Composite Measures of Health Care Provider Performance: A Description ofApproaches. Milbank Q. 2015 Dec 1;93(4):788.
5. Ring JC, Chao SM. Performance measurement: accelerating improvement. 2006.
6. Lorencatto F, West R, Christopherson C, Michie S. Assessing fidelity of delivery of smoking cessation behavioural support in practice. Implement Sci. 2013 Apr 4;8(1).
7. Lorencatto F, West R, Bruguera C, Michie S. A method for assessing fidelity of delivery of telephone behavioral support for smoking cessation. J Consult Clin Psychol. 2014;82(3):482–91.
8. Toomey E, Currie-Murphy L, Matthews J, Hurley DA. Implementation fidelity of physiotherapist-delivered group education and exercise interventions to promote

selfmanagement in people with osteoarthritis and chronic low back pain: a rapid review part II. Man Ther. 2015 Apr 1;20(2):287–94.

9. Narh-Bana SA, Kawonga M, Chirwa, Esnat D LI, Bonsu F, Chirwa TF. Fidelity of implementation of TB screening guidelines by health providers at selected HIV clinics in Ghana. 2021;(135):1–21.

10. Narh-Bana SA, Chirwa TF, Chirwa ED, Bonsu F, Ibisomi L, Kawonga M. Adherence of HIV clinics to guidelines for the delivery of TB screening among people living with HIV / AIDS in Ghana. 2021;9:1–13.

11. Lebina L, Alaba O, Ringane A, Hlongwane K, Pule P, Oni T, et al. Process evaluation of implementation fidelity of the integrated chronic disease management model in two districts, South Africa. BMC Health Serv Res. 2019 Dec 16;19(1):1–14.

12. Limbani F, Goudge J, Joshi R, Maar MA, Jaime Miranda J, Oldenburg B, et al. Process evaluation in the field: Global learnings from seven implementation research hypertension projects in low-and middle-income countries. BMC Public Health. 2019;19(1).

13. Sharma S, Adetoro OO, Vidler M, Drebit S, Payne BA, Akeju DO, et al. A process evaluation plan for assessing a complex community-based maternal health intervention in Ogun State, Nigeria. BMC Health Serv Res. 2017 Mar 28;17(1).

14. Walton H, Spector A, Tombor I, Michie S. Measures of fidelity of delivery of, and engagement with, complex, face-to-face health behaviour change interventions: A systematic review of measure quality. Br J Health Psychol. 2017 Nov 1;22(4):872–903.

15. Toomey E, Matthews J, Hurley DA. Using mixed methods to assess fidelity of delivery and its influencing factors in a complex self-management intervention for people with osteoarthritis and low back pain. BMJ Open. 2017 Aug 1;7(8).

16. Cooper C, O'Cathain A, Hind D, Adamson J, Lawton J, Baird W. Conducting qualitative research within Clinical Trials Units: avoiding potential pitfalls. Contemp Clin Trials. 2014;38(2):338–43.

17. Borrelli B. The assessment, monitoring, and enhancement of treatment fidelity in public health clinical trials. J Public Health Dent. 2011 Dec;71(SUPPL. 1).

18. McKenna JW, Flower A, Ciullo S. Measuring fidelity to improve intervention effectiveness. Interv Sch Clin. 2014 Jan 1;50(1):15–21.

19. Moncher FJ, Prinz RJ. Treatment fidelity in outcome studies. Clin Psychol Rev. 1991;11(3):247–66.

20. Munafò MR, Davey Smith G. Repeating experiments is not enough. Nature. 2018 Jan 25;553(7689):399–401.

21. Creswell JW. A concise introduction to mixed methods research. United States Am SAGE. 2014;

22. Puchalski Ritchie LM, Kip EC, Mundeva H, Van Lettow M, Makwakwa A, Straus SE, et al. Process evaluation of an implementation strategy to support uptake of a tuberculosis treatment adherence intervention to improve TB care and outcomes in Malawi. BMJ Open. 2021 Jul 1;11(7):e048499.

23. Carroll C, Patterson M, Wood S, Booth A, Rick J, Balain S. A conceptual framework for implementation fidelity. Implement Sci. 2007 Dec;2(1):1–9.

24. Pérez D, Van der Stuyft P, Del M, Zabala C, Castro M, Lefèvre P, et al. A modified theoretical framework to assess implementation fidelity of adaptive public health interventions. Implement Sci. 2016 Jul;11(1):91.

25. Ghana Health Service. Implementation Plan for Isoniazid Preventive Therapy in Ghana. 2017.

26. Ghana Health Service. Implementation of TB / HIV collaborative activities in Ghana: Technical policy and guidelines. 2007.

27. Spiliotopoulou G. Reliability reconsidered: Cronbach's alpha and paediatric assessment in occupational therapy. Aust Occup Ther J. 2009 Jun 1;56(3):150–5.

28. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ. 2011 Jun 27;2:53–5.

29. Huijg JM, Gebhardt WA, Dusseldorp E, Verheijden MW, van der Zouwe N, Middelkoop BJC, et al. Measuring determinants of implementation behavior: Psychometric properties of a questionnaire based on the theoretical domains framework. Implement Sci. 2014 Mar 19;9(1):33.

30. Durlak JA, DuPre EP. Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. Am J Community Psychol. 2008 Jun;41(3–4):327–50.

31. Mihalic S. The Importance of Implementation Fidelity. 2002.

32. Bellg AJ, Resnick B, Minicucci DS, Ogedegbe G, Ernst D, Borrelli B, et al. Enhancing treatment fidelity in health behavior change studies: Best practices and recommendations from the NIH Behavior Change Consortium. Vol. 23, Health Psychology. 2004. p. 443–51.

33. Abry T, Hulleman CS, Rimm-Kaufman SE. Using Indices of Fidelity to Intervention Core Components to Identify Program Active Ingredients. Am J Eval. 2015 Sep 6;36(3):320–38.

34. Cofie P, De Allegri M, Kouyaté B, Sauerborn R. Effects of information, education, and communication campaign on a community-based health insurance scheme in Burkina Faso. Glob Health Action. 2013;6:20791.

8.0 General Discussion and Conclusion

8.1 Overview

The global health system faces the challenge of implementing an evidence-based intervention in the real-world setting (30). However, the how and extent of the implementation comes with a price. The discourse and measurement of implementation fidelity and determinants provide a link between intervention implementation and outcomes with an understanding of the performance of the intervention. This PhD applied a cross-sectional study method in selected district hospitals across the ten traditional regions of Ghana to assess the fidelity and determinants of implementing the TB screening with people living with HIV attending HIV clinics in Ghana. This concluding chapter discusses the key findings of the research.

The opening sections present discussions on the context of the study. The choice of method for the data collection and the strategies adopted to conduct the study.

Following the opening section, we discussed the separate fidelities assessed with regard to the primary outcomes of the study. The discussion focuses mainly on the fidelity of delivery ascertained from the provider, facility and the combination of provider and facility levels. It also addressed the relationship between the moderating factor and the various fidelities of delivery. Finally, as one of the study's endpoints, we assessed the implementation determinants to the TB screening program with PLHIV visiting HIV clinics in Ghana.

Towards the end of this section, we present some lessons learned throughout the study on translating research outcomes into policy in district hospitals and HIV/ART clinics. Finally, we discussed the strengths and weaknesses of the research and the consequence of our findings on future research, policy and practice.

8.2 General discussion

8.2.1 Contextual conduct of the study

The TB screening amongst PLHIV attending HIV clinics is a vital intervention targeted at lessening the burden of TB on PLHIV/AIDS in countries where TB and HIV are endemic. Transferring an evidence-based intervention into real-life settings and making it part of the

system is complex. An implementation assessment is critical to accurately interpret intervention outcomes observed in a particular intervention. Durlak and DuPre confirmed that fidelity assessment determines the extent to which the intervention outcome is influenced. (20)

In this study, we assessed the fidelity of implementing the intervention at the facility, provider and combined facility-provider levels quantitatively using face-to-face interviews with HIV healthcare providers and facility record review. The face-to-face approach was appropriate for this study under the prevailing circumstances; HIV is seriously stigmatised in Ghana (150,151). As a result of the stigmatisation level in Ghana, most of these HIV clients are known to come from outside the facility's catchment area to avoid people getting to know their HIV statuses. Therefore, in this instance, data collection by observation might not be appropriate. However, given enough time and funding, other approaches would have been employed to collect the data. Notwithstanding, the mix of desk review and face-to-face was enough to answer the objectives of this study.

8.2.3 Provider Level Fidelity

The principal activities on the clinical protocol include but are not limited to TB education, counselling, screening using the TB screening algorithm, requesting for confirmatory test and initiation of IPT or appropriate treatment. Therefore, each HIV healthcare worker expects to apply the clinical protocol to every HIV client who visits the ART/HIV clinic (1,7,15). The various activities in the clinical protocol for the HIV healthcare providers were grouped under TB diagnoses, TB awareness, and TB symptoms questionnaire components and assessed their fidelity.

The fidelity of HIV healthcare providers to the intervention, in the long run, contributes enormously to the success of the TB/HIV collaborative programme. This is because the HIV healthcare providers are almost at the final implementation stage and have direct contact with HIV clients. In all, this study documents a high implementation fidelity score among the HIV healthcare provider with a median score of 79%. The number of healthcare providers who delivered the TB screening intervention with high fidelity was marginally high – 6% more than those who implemented with low fidelity. Similarly, among the three components, we observed a fidelity score of 53%, TB awareness lower than scores on the TB diagnosis and TB symptoms questionnaire. Effective awareness through health education and counselling on TB is integral

to a successful implementation of the intervention, with clarity and focus on the importance of the intervention to the client.

The continuous persistence of TB in Ghana is primarily due to patients' noncompliance (152) and possibly loss to follow-ups. Therefore, adherence to the intervention components, particularly the awareness component by the healthcare providers, will improve adherence in patients with or without TB. Effective implementation of the TB screening intervention will result in high patient compliance and treatment success coupled with minimal loss to follow-ups among PLHIV. Consequently, the TB/HIV comprehensive care approach is keenly centred on patient education and counselling. Education and counselling are the bedrock for understanding, acceptability, and delivery of the other components of the intervention. In addition, good education and counselling promote trusted patient and healthcare provider relationships and improve patients' health-seeking behaviour. An HIV client with much trust for the healthcare provider is more likely to cooperate with the healthcare provider and follow advice. Therefore, providers will deliver as designed by the intervention programmers and extend to provide social support, mental health care, and other health promotion activities targeting the broader community on HIV/TB.

8.2.4 Programme/Facility Level Fidelity

The role of facilities in the implementation strategy of the TB screening intervention in controlling TB infection among PLHIV cannot be overlooked. Facilities establish implementation activities and procedures and determine and organize resources according to the implementation plan and requirement. The baseline for determining the facility fidelity level in this study was the presence and practice of the critical components, including intensive TB case-finding among PLHIV (ITCF), IPT initiation (IPT) in HIV clients confirmed of not having TB, TB infection control (TIC) and the programme review meeting (PRM).

This study documents high adherence scores for delivering the ITCF, TIC and PRM components. The programme review meeting component obtained the highest adherence score of 90%. A quarterly TB review meeting was expected to be conducted at all levels to address all implementation challenges (71). In addition, the implementation of the infection control components is crucial in implementing the TB screening intervention because of its substantial public health benefit at both the HIV healthcare provider and the client levels. However, in

general, the implementation of TIC measures in the West African region was low (16), contrary to our findings. Our study was conducted in some selected district hospitals where general infection control is part of the management plan of action.

In contrast, the IPT initiation component was poor. In Addition, the study generally shows that 63% of the facilities adhere well to the implementation guideline – i.e., most scoring above the median score of 62.%. However, contrary to this finding, a study conducted by Charles et al. (2015) assessing the implementation of the intensive case finding (ICF), isoniazid preventive therapy (IPT), and infection control ("Three I's") of TB control at HIV treatment sites in lower-income countries shows poor integration of guidelines and low implementation of HIV and TB services (16).

The level of delivery of IPT components in our study influenced the overall adherence level documented. The use of IPT among HIV positives has not been fully operationalised yet in Ghana. IPT is currently used in specialised cases under clinicians' observation at selected hospitals in the country. However, in many countries, including Tanzania (153), Kenya (154), Ethiopia (155) and South Africa (156), where TB and HIV are public health issues, IPT is being used to protect all PLHIV against active TB. The use of IPT was a recommendation by the WHO as an effective treatment for reducing TB incidence. Nevertheless, a study (16) conducted in the leDEA regions shows that IPT use for all adults living with HIV in whom active TB was diagnosed to be negative was generally low. The IeDEA consortium is an international research network of HIV care and treatment sites situated in seven regions globally. The level of implementation varies by region that reported from Asia/Pacific (17%), the Caribbean, Central and South America (CCASAnet (29)), Central Africa (0%), East Africa (12%), Southern Africa (21%), and West Africa (14%). These findings on IPT implementation resonates with our result.

In general, the facility fidelity level covers the area of resources and training provided to support HIV care providers. For example, in terms of resources, most facilities studied possess TB screening questionnaires (74.1%) and guidelines (77.8%) at the HIV clinics. Nonetheless, other supplies such as TB/HIV clinical manuals, TB IE&C materials, and TB prevention and infection control guidelines are unavailable in most HIV clinics.

8.2.5 Combined provider and programme fidelity scores

Policy guidelines and activities for facility managers and healthcare providers to implement an intervention within the health facility are interdependent. For instance, the healthcare providers depend on the facility managers to provide the resources to implement the intervention in the facility and vice versa. To the best of our information, this is one of the first studies that assessed the overall implementation fidelity of delivery as a combination of provider and facility level core activities of the intervention.

This study documented a noteworthy overall (weighted) fidelity level. The study demonstrated a median weighted fidelity score of 67%, showing that only about half of the facilities were classified as high-fidelity facilities. These proportions of fidelity levels observed reflects the existing low and fluctuating level of the TB screening coverage (24). For instance, in 2018, when this study was conducted, according to the District Health Information Management System version 2 (DHIMS2) and programme data available, TB screening coverage was 40%, far below the target of 80%. According to the revised implementation of TB/HIV joint activities guidelines in Ghana (24), the TB screening intervention was expected to improve TB screening coverage. Nonetheless, Caroll et al. (2007) showed that the level of implementation fidelity influences programme outcome (27). Hence, the overall fidelity and TB screening coverage relationship was established in this study.

This study found a strong positive relationship between TB screening coverage and overall implementation fidelity. The higher the implementation fidelity, the higher the TB screening coverage. Kalafat and others also found a statistically significant association between an overall **facility** fidelity and program level outcome (157). Other studies (111,158) found a significant association between overall implementation fidelity and observed outcome.

This study assessed the facility level implementation fidelity and the provider level implementation fidelity separately and the combined facility-provider level fidelity. Comparing these three fidelities related to TB screening coverage showed that the combined fidelity was a better model for assessing implementation fidelity in health facilities. For instance, the model with the combined fidelity showed a good fit and a marked difference compared to the models with the separate fidelities. In addition, although the model with provider level fidelity showed a good fit, the statistics for assessing good fit (F-test, RSME, p-value, R-squared, adjusted R-squared) were much better in the model with the combined fidelity. Hence, the weighted fidelity as a composite (overall) fidelity provided a clearer picture

of the general performance by the facilities on the extent to intervention delivery. Furthermore, evidence provided in this assessment includes information that facilitates evaluation and comparison and acts as a driver of behaviour change (159). Therefore, the separate fidelities contribute relative performance to implementing the intervention.

In contrast, the overall fidelity assessment is critical for determining its holistic performance contribution to implementing the intervention within the facility. Facility managers face relative advantage challenges in prioritising limited resources for the implementation. Failure to prioritise the needed direction affects the healthcare provider's performance. The overall fidelity assessment relates to the health system performance assessment because it provides a valuable source of information for policymakers and intervention designers in their decision-making on implementation strategies and resource allocation (160).

8.2.6 Moderating factors of the implementation fidelity

We assessed factors influencing the fidelity of the TB screening intervention delivery separately for provider, facility, and combined levels. The factors that influenced implementation fidelity at the healthcare provider level consisted of gender, cadre and the level of education of the healthcare provider. Facilities, where most HIV healthcare providers have a higher educational level with a clinical background, have a high fidelity level, similar to what other studies (161,162) found. Most studies also found that clinicians adhered poorly to guidelines (163,164); however, compared to non-clinicians in our study, clinicians' adherence is better. Competency is the skill and ability to perform a task influenced by profession and educational level. Therefore, Clinicians (medical assistants, professional nurses and auxiliary nurses) with post-secondary and tertiary education were more competent than non-clinicians and upper secondary academic level healthcare providers.

At the facility level, factors relating to physical facilities and resources (including the TB screening questionnaire and TB screening guidelines availability), and health facility utilisation and staffing workload (including the number of PLHIV attending HIV clinics per month and number of patients per provider per month) significantly influenced facility level fidelity. Guidelines and resources availability is known to lead to simplified and standardised delivery of an intervention(165,166). In our study, high fidelity scoring facilities had significantly fewer clients who visit the HIV clinics monthly and lower monthly workloads than low fidelity

scoring facilities. In addition, it is worth noting that facilities with low fidelity had limited or no resources like the TB screening questionnaires and guidelines. A similar finding was acknowledged by Nansera et al. (2010) that understaffing and shortage of policy guidelines meant to facilitate the intervention are barriers to integrated TB/HIV services (167).

At the combined level, supplies including IE&C materials availability emerged as a significant predictor of weighted fidelity of delivery. Facilities with IE&C materials obtained higher weighted fidelity scores than facilities without IE&C materials. IE&C materials help provide knowledge and increase participation to impact (168).

Once all these moderators identified improve, the corresponding effect will enhance the delivery of the various intervention components. Ultimately, the implementation of the TB screening will be successful. This study corroborates existing knowledge that high fidelity (successful implementation) is associated with intervention outcome (20,88,169).

8.2.7 Determinants of implementation

Besides the relationship between moderating factors and fidelity of delivery, the study qualitatively explored the implementation determinants of the TB screening intervention at the HIV clinics in Ghana. Using the Consolidated Framework for Implementation Research as a guide, we grouped the determinants found under the four domains applicable to the study. These domains are the characteristics of the intervention, outer setting, inner setting and individual characteristics.

At the intervention characteristics level, ease of the TB screening tool, goal setting, feedback and supervision were facilitators. Other studies have mentioned these factors as essential strategies to promote implementation (170,171), following goal setting with feedback and supervision, improved implementation of intervention improved (109,172). At the same time, transport cost for sputum collected was a barrier to implementing the TB screening intervention. Also, once healthcare providers see the intervention as complex, the expected outcome will have challenges. In a real-life setting, expectations about results are subject to factors, including the complexity of the intervention (173). The cost of collecting sputum was found as an implementation barrier under intervention characteristics. Having good knowledge

of and addressing the non-labour cost for implementing an intervention strategy will reduce gaps and help implement interventions well (174).

At the Outer setting level, factors such as good referral relationships and chemical sellers key in community case-finding were promoters of the implementation. Good networking and good external stakeholders play an essential role in implementing any health intervention. A sound referral system confirms a good relationship between all stages of the health system. Amongst the advantages is an enhancement of implementation of an evidence-based health intervention like the TB screening with PLHIV attending HIV clinics. Stakeholders like the chemical sellers help promote and sustain the healthcare system up to date with the latest intervention and respond convincingly to new interventions (161) to improve the lives of the people they serve.

The next domain of the CFIR that this study explored was the inner setting. With this domain, we found renovation and innovations as facilitators of the implementation. Innovation has been identified to influence implementation, and innovative facilities build an atmosphere conducive to attempting new methodologies (20,175). Nonetheless, limited or lack of privacy and inadequate space in other facilities to conduct the TB screening hindered the implementation. Consistent with our findings, Ayakaka et al. sought to explore the barriers and facilitators of TB contact tracing found insufficient space and lack of privacy for TB care, including counselling that required dedicated space (176) in settings where stigma is an issue.

Finally, the fourth domain, individual characteristics, consisted of the acceptability of intervention as a facilitator and the commitment of healthcare providers as barriers to implementing the TB screening intervention. Acceptability of healthcare interventions to healthcare providers is a pertinent issue that requires consideration in the development and implementation stages (177). A study (178) also revealed that the acceptability of healthcare intervention might result in the improved implementation of the intervention in a real-life setting. However, other studies have also documented that healthcare providers' low or poor commitment inhibits the successful implementation of healthcare intervention (18,138). For instance, Howard et al. (18) believed that the level of commitment by facility managers trickle down to healthcare providers who turn to influence the implementation of health care interventions.

8.2.8 Linkage between findings and conceptual framework

This study has confirmed the level of fidelity of delivery and the relationships between moderating factors and fidelity at the different levels of delivery of the TB screening intervention at HIV clinics, as indicated in the conceptual framework for this thesis (Figure 4). It has recognised different components of factors affecting fidelity at the provider, facility and combined levels. The study identified factors that determine the intervention's success or failure. The process domain of the Consolidated Framework for Implementation Research was not explored in this study and therefore, needs further research.

8.2.9 Limitations of the study

This study has some limitations and challenges that has to be considered when using the finding. We have discussed these limitations, peculiar to each of the papers, in detail in chapters 4 to 7. This section, however, presents two significant limitations regarding the conduct of this study.

The first limitation was using a self-response approach to collect the data. This type of approach leads to self-response bias or social desirability bias. Respondents may exaggerate their responses based on their knowledge about the research to look favourable rather than what they do regarding the intervention. This might introduce inaccuracy in the research findings. However, we used a third party to collect data and assured the participants' complete confidentiality and anonymity. This made the participants very open and answered our questions in details without any cause for alarm. The questions were also closed-ended and devoid of questions that would warrant respondents to provide an absolute categorical answer. This, we were sure, has minimised the bias.

The second limitation was the number of FGDs conducted per facility. Although qualitative studies rely on satisfaction and saturation, this study has identified and conducted 1 FGD per facility from 8 out of 27 facilities. Because of small numbers, we could therefore not present facility-specific results but combined, analysed and presented the findings of the qualitative study as a whole. Nonetheless, the barriers and facilitators are applicable and generalisable to similar facilities.

The last limitation was our inability to address the IPT initiation aspect of the study. Although the main interest of this research was to focus on the screening guidelines adherence point of

view and not necessarily to fully address IPT initiation. Nonetheless, our study found revealed that IPT initiation has not been implemented as planned. However, we addressed the IPT initiation partially as a component of facility adherence assessment of the implementation. Hence, exploring other reasons why the IPT initiation was not implemented as expected was beyond the scope of the study.

8.2.10 Strengths of the study

Notwithstanding the limitations mentioned above, this study has some important strengths worth discussing. First, the study contributes usefully to understanding the assessment of fidelity at diverse levels of the health facility system. Fidelity assessments usually were conducted at the provider level, with few at the facility level. This study evaluated fidelity at the facility, provider, and combined facility-provider levels in the same facility. In addition, the weighted fidelity assessment through the combination of provider-facility activities add to the existing approaches to fidelity evaluation. Hence, this piece of work contributes strongly to what is already known about fidelity assessment.

The study significantly contributes to establishing a cut-off point for categorising fidelity into levels. This is a vital strength of the study because the cut-off point for setting the level of fidelity is missing in implementation science literature.

An additional strength of this study is the methods used. The use of various data collection methods, including purely census-based, face-to-face interviews, record reviews, focus group discussions, and individual in-depth interviews, produced more comprehensive and reliable results than using one method.

And finally, full participation of the PhD student in the fieldwork safeguards the quality of data collection and interpretation of the results, particularly with regards to the qualitative data.

8.2.11 Implication for research

This study revealed gaps in the information that needed to be addressed to provide a complete picture of the performance of the intervention. For example, it was anticipated that all the 27 district hospitals studied would all have functioning HIV/ART clinics, conduct TB amongst people living with HIV, and have both X-ray and GenXpert machines for the confirmation of

the presence of TB in the district hospital. This was the case in all the selected 27 district hospitals. It was also expected that all the facilities studied were indeed earmarked to have begun the initiation of IPT to PLHIV, who were confirmed of not having TB. It was indeed the case, but the initiation had been delayed. And it was also expected that all the components at both provider and facility levels are implemented fully, especially at the facility level where facilities, resources, and procedures are discoursed and supplied to the core implementers (providers). These would have led to higher fidelity levels. The fact that these latter outcomes were not established revealed some grey areas which have implications for research, such as:

- What are the proportional shares of the different provider level components of the intervention to the fidelity levels in the study area?
- What are the proportional shares of the different facility-level components of the intervention to the fidelity levels in the study area?
- What are the proportional shares of all the intervention components to the composite fidelity level in the study area?
- How has the level of fidelity observed impacted the intervention outcomes in the study area?

There has been no prior study that ever measured the proportional share of the intervention components to fidelity at the provider level or facility level or composite of both in the study area or assessed the impact of fidelity level on the health outcomes of the intervention. In addition, a study such as this current one is yet to be conducted in other facilities where the TB screening among HIV clients has been ongoing over some time but do not have both X-ray and geneXpert machines to confirm the test.

The responses to these inquiries should offer more evidence to advance knowledge on the subject of implementation determinants and fidelity of TB screening amongst PLHIV attending HIV clinics in Ghana.

8.2.12 Implication for policy and practice

The level of fidelity determined in this study characterised by the TB screening coverage observed over time since the implementation of the intervention in Ghana (15,24) is evidence that the intervention is under-or partially implemented. This evidence should show the same in many other similar facilities in Ghana, where the intervention is ongoing. The fidelity level at

the provider level compared to the fidelity level at the facility level showed a clear difference. The facility-level saw a higher proportion implementing the intervention at a high fidelity level. The research saw 53% and 63% respectively implementing the intervention with high fidelity at the provider and facility levels. This finding raises the possibility that the level at which adherence is assessed may not necessarily translate into the extent to which the intervention is implemented; this needs to be tested in other studies.

However, assessing implementation fidelity should go hand in hand with evaluating its related factors. In this study, provider fidelity is influenced by the level of education and the calibre of the provider. Nonetheless, at the facility level, fidelity is influenced by workload and the availability of intervention resources. Therefore, an intervention to ensure regular and additional training on implementing all critical constructs of the intervention will increase fidelity amongst HIV healthcare providers and realise the aims of the TB screening intervention amongst PLHIV in Ghana.

Implementation determinants – barriers or facilitators – are credible means for improving the implementation process of intervention (85,176). Understanding these barriers or facilitators guides the selection of appropriate ways to improve the TB screening intervention implementation. The implementation of such an intervention would be more successful if the barriers – limited space for screening. Low commitment from health workers, etc. were addressed while promoting the enablers – good networking, cordial monitoring and supervision, uncomplicated nature of the intervention, etc

This research revealed where the intervention designers could target actions to improve its implementation to realise potential benefits. In addition, lessons learned from the **facility** and the provider level fidelities may be relevant in scaling up the intervention to other health facilities and related interventions.

8.2.12 Contribution of PhD

This study is the first to understand the reason behind the low and fluctuating coverage for TB screening among PLHIV in Ghana. Furthermore, it assesses the degree and determinants of the TB screening intervention implementation amongst PLHIV attending HIV clinics in Ghana.

Assessment of fidelity or adherence at the facility level is not common in literature. This study added to the literature on assessing implementation fidelity within the health sector.

Fidelity assessments mainly were conducted at the provider level, with a handful at the facility level. This PhD, through this study, had demonstrated that overall fidelity could be assessed as a combination of provider and facility level components. This process resulted in a combined fidelity, an advancement in knowledge and methodological innovation in implementation science.

8.3 General Conclusion

Implementation research provides enough idea into how fidelity of delivery and related factors are assessed to enhance the implementation of health interventions, particularly for underprivileged people.

This study set out to assess the fidelity of delivery and explore the implementation determinants of the TB screening intervention among HIV clients attending HIV clinics in selected district hospitals in Ghana. This PhD applied existing methodologies innovatively to understand the fidelity of delivery at different levels and the implementation determinants associated with implementing the TB screening intervention.

In conclusion, we demonstrated through this study that implementation fidelity is assessable at the programme/facility, provider and combined (provider-facility) levels of the healthcare delivery. We documented a high fidelity level among HIV healthcare providers and a marginally high fidelity level among the facilities. In addition, the study revealed a substantially high fidelity among facilities using the combined fidelity approach. There is a strong positive association between TB screening coverage and combined fidelity. The combined fidelity proved to provide an effective way of assessing the implementation fidelity of a health intervention at the health facility level than the separate fidelity. Therefore, assessment of fidelity using the combined approach would clearly portray the picture of the extent of implementation.

The study clarifies that full delivery of the critical components of the intervention by facility managers and core healthcare providers jointly will improve implementation fidelity.

The moderating factors related to the provider fidelity of delivery were gender, profession and education level of the HIV healthcare provider. At the facility level, the moderators were availability of resources factors such as TB screening questionnaire and TB screening guidelines, number of PLHIV attending HIV clinic monthly, and the number of patients per provider monthly. And finally, at the combined level, the moderator was the availability of IE&C materials on TB screening.

Additionally, implementation determinants of the intervention, such as *ease of TB screening tool, feedback and supervision, good referral relationships, chemical sellers key in community case finding, renovations and innovations, and high acceptability of intervention among providers,* facilitated the implementation. Conversely, the study documented factors such as *transport costs for sputum collection, limited or lack of privacy and inadequate space to conduct TB screening, and low commitment of care providers* as hindering the implementation.

References

1. Getahun H, Van Gorkom J, Harries A, Harrington M, Nunn P, Perriens J, et al. Interim Policy on Collaborative TB/HIV Activities. TB/HIV Research FoundationRegional Office for Africa South Africa). Paul Nunn Paul Pronyk; 2004.
2. WHO. Global TB Report 2017. 2018.
3. Getahun H, Gunneberg C, Granich R, Nunn P. HIV Infection–Associated Tuberculosis: The Epidemiology and the Response. Clin Infect Dis. 2010 May 15;50(s3):S201–7.
4. Daley CL, Hahn JA, Moss AR, Hopewell PC, Schecter GF. Incidence of Tuberculosis in Injection Drug Users in San Francisco. Am J Respir Crit Care Med. 1998 Jan 14;157(1):19–22.
5. World Health Organization. Global tuberculosis control. 2010.
6. Ansa GA, Sifa JS. Tuberculosis and HIV integration in sub-Saharan Africa. Asian Pacific J Trop Dis. 2015;5(11):841–9.
7. WHO. WHO policy on collaborative TB/HIV activities Guidelines for national programmes and other stakeholders. 2012.
8. Anku PJ, Amo-Adjei J, Doku DT, Kumi-Kyereme A. Integration of tuberculosis and HIV services: Exploring the perspectives of co-infected patients in Ghana. Glob Public Health. 2017 Oct 6;1–12.
9. Addo KK, Ampofo WK, Owusu R, Bonsu C, Nartey N, Mensah GI, et al. First Nationwide Survey of the Prevalence of TB/HIV Co-Infection in Ghana. J Tuberc Res. 2018 May 9;06(02):135–47.
10. Stop TB Partnership. Improving Tuberculosis Case Detection:A compendium of TB REACH case studies, lessons learned and a monitoring and evaluation framework. 2010.
11. Mhimbira FA, Cuevas LE, Dacombe R, Mkopi A, Sinclair D. Interventions to increase tuberculosis case detection at primary healthcare or community-level services. Cochrane Database Syst Rev. 2017 Nov 28;
12. Date A, Modi S. TB Screening Among People Living With HIV/AIDS in Resource-Limited Settings. JAIDS J Acquir Immune Defic Syndr. 2015 Apr 15;68:S270–3.
13. Uyei J, Coetzee D, MacInko J, Weinberg SL, Guttmacher S. Measuring the degree of integrated tuberculosis and HIV service delivery in Cape Town, South Africa. Health Policy Plan. 2014;29(1):42–55.
14. Ansa GA, Walley JD, Siddiqi K, Wei X. Delivering TB/HIV services in Ghana: a comparative study of service delivery models. Trans R Soc Trop Med Hyg. 2014;tru110.
15. Ghana Health Service. Implementation of TB / HIV collaborative activities in Ghana: Technical policy and guidelines. 2007.
16. Charles MK, Lindegren M Lou, Wester CW, Blevins M, Sterling TR, Dung NT, et al. Implementation of Tuberculosis Intensive Case Finding, Isoniazid Preventive Therapy, and Infection Control ("Three I’s") and HIV-Tuberculosis Service

Integration in Lower Income Countries. Ivanyi J, editor. PLoS One. 2016 Apr 13;11(4):e0153243.

17. Fenner L, Forster M, Boulle A, Phiri S, Braitstein P, Lewden C, et al. Tuberculosis in HIV Programmes in Lower-Income Countries: Practices and Risk Factors.

18. Howard AA, El-Sadr WM. Integration of Tuberculosis and HIV Services in Sub-Saharan Africa: Lessons Learned. Clin Infect Dis. 2010;50(S3):238–44.

19. World Health Organization W. Global Tuberculosis Control. 2009.

20. Durlak JA, DuPre EP. Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. Am J Community Psychol. 2008 Jun;41(3–4):327–50.

21. Proctor E, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, et al. Outcomes for Implementation Research : Conceptual Distinctions , Measurement Challenges , and Research Agenda. 2011;65–76.

22. Dusenbury L, Brannigan R, Hansen WB, Walsh J, Falco M, Ghana NACP, et al. Quality of implementation: developing measures crucial to understanding the diffusion of preventive interventions. Who. 2014 Jun 1;15(1):1–9.

23. Ghana Health Service. Implementation plan for IPT, Ghana [Internet]. 2017 [cited 2018 Jul 24]. Available from: https://www.google.co.za/search?q=IPT+for+TB+prevention+in+Ghana&oq=IPT+for+TB+prevention+in+Ghana&aqs=chrome..69i57.12706j1j8&sourceid=chrome&ie=UTF-8

24. Ghana Health Service. Implementation of TB/HIV collaborative activities in Ghana: Joint programme planning policy and guidelines. 2014.

25. Rediet Abebe, Mistre Fantahun, Yirgalem HaileMichael MY and MM. HIV Testing and Counseling among Patients with Tuberculosis at Arbaminch Hospital, Southern Ethiopia. Biomed Sci Technol. 2014;

26. Durlak JA. The importance of implementation for research, practice, and policy. Child Trends. 2011;34:1–10.

27. Carroll C, Patterson M, Wood S, Booth A, Rick J, Balain S. A conceptual framework for implementation fidelity. Implement Sci. 2007 Dec;2(1):1–9.

28. Sidani S. Fidelity of Intervention Implementation: A Review of Instruments. Health (Irvine Calif). 1980;7:1687–95.

29. Lewis CC, Fischer S, Weiner BJ, Stanick C, Kim M, Martinez RG. Outcomes for implementation science: an enhanced systematic review of instruments using evidence-based rating criteria. Implement Sci. 2015 Dec 4;10(1):155.

30. Peters DH, Tran NT, Adam T. Implementation Research in Health: A Practical Guide. Who. 2013;69.

31. Britanica Encyclopaedia. Ghana | Culture, History, & People | Britannica.

32. Issahaku, Francis; Aabeyir, Francis; Laari P. Overview of the Influence of Natural Resources and Population Distribution on Spatial Development in Ghana. J Environ Earth Sci. 2017;4:133–48.

33. Ghana Statistical service. CountrySTAT - Ghana. 2020.

34. Bank W. Current health expenditure (% of GDP) - Ghana | Data.

35. Fund G. The Global Fund. 2015.

36. Kanmiki EW, Bawah AA, Phillips JF, Awoonor-Williams JK, Kachur SP, Asuming PO, et al. Out-of-pocket payment for primary healthcare in the era of national health insurance: Evidence from northern Ghana. PLoS One. 2019/08/21. 2019;14(8):e0221146.

37. Ghana Ministry Of Health. Ghana Health Service - Ministry Of Health. 2020.

38. Ghana Health Service. The Health Sector in Ghana. Accra; 2018.

39. Pharmaccess Foundation. A Closer Look at the Healthcare System in Ghana. 2016.

40. Scheme GNHI. NHIS Review: Terms of Reference for Defining Options for National Health Insurance Scheme Reforms. Vol. 2019. Accra: Ghana National Health Insurance Scheme; 2019.

41. World Health Organisation. Global tuberculosis report 2019. Geneva; 2019 Oct.

42. World Health Organisation. Tuberculosis: Key facts. 2019.

43. World Health Organization. Latent tuberculosis infection Updated and consolidated guidelines for programmatic management. Geneva; 2018.

44. World Health Organisation. TB comorbidities and risk factors. 2019.

45. The Global Fund. Assessment and Best Practices of Joint TB and HIV Applications Progress, Challenges, and Way Forward itle). Geneva, Switzerland; 2019.

46. Uthman OA, Yahaya I, Ashfaq K, Uthman MB. A trend analysis and sub-regional distribution in number of people living with HIV and dying with TB in Africa, 1991 to 2006. Int J Health Geogr. 2009 Nov 24;8.

47. World Health Organisation. TB Treatment and care. 2019.

48. Nations U. Sustainable Development Goals. Vol. 2019. Geneva: United Nations; 2019.

49. World Health Organisation. The End TB Strategy. WHO. World Health Organization; 2015.

50. Adeiza, Abba AA, Okpapi JU. HIV-Associated tuberculosis: A sub-saharan african perspective. Sub-Saharan African J Med. 2014;1(1):1.

51. World Health Organisation. WHO | Progress report 2011: Global HIV/AIDS response. WHO. World Health Organization; 2011.

52. World Health Organization. Global tuberculosis control: WHO report 2011. 2011.

53. Dye C, Scheele S, Dolin P, Pathania V, Raviglione MC. Global burden of tuberculosis: Estimated incidence, prevalence, and mortality by country. J Am Med Assoc. 1999 Aug;282(7):677–86.

54. Vynnycky E, Fine PEM. Lifetime Risks, Incubation Period, and Serial Interval of Tuberculosis Vynnycky and Fine Lifetime Risks, Incubation Period, and Serial Interval of Tuberculosis. Vol. 152, American Journal of Epidemiology. 2000.

55. Dye C, Harries AD, Maher D, Hosseini SM, Nkhoma W, Salaniponi FM. Disease and Mortality in Sub-Saharan Africa. 2nd edition. Chapter 13. Tuberculosis. 2006;

56. World Health Organisation. WHO | TB/HIV facts 2015. 2015.

57. World Health Organization W. WHO | WHO Three 'I's meeting: intensified case finding, isoniazid preventive therapy and TB infection control for people living with HIV. WHO. 2015;

58. Habib AG. A clinical and epidemiologic update on the interaction between tuberculosis and human immunodeficiency virus infection in adults. Vol. 8, Annals of African Medicine. Medknow Publications and Media Pvt. Ltd.; 2009. p. 147–55.

59. World Health Organisation. Guidelines for intensified tuberculosis case-finding and isoniazid preventive therapy for people living with HIV in resource-constrained settings. Geneva; 2011.

60. Coetzee D, Hilderbrand K, Goemaere E, Matthys F, Boelaert M. Integrating tuberculosis and HIV care in the primary care setting in South Africa. Trop Med Int Heal. 2004 Jun;9(6):A11–5.

61. Izudi J, Semakula D, Sennono R, Tamwesigire IK, Bajunirwe F. Treatment success rate among adult pulmonary tuberculosis patients in sub-Saharan Africa: A systematic review and meta-analysis. BMJ Open. 2019 Sep;9(9):29400.

62. Budgell EP, Evans D, Schnippel K, Ive P, Long L, Rosen S. Outcomes of treatment of drug-susceptible tuberculosis at public sector primary healthcare clinics in Johannesburg, South Africa: A retrospective cohort study. South African Med J. 2016 Oct;106(10):1002–9.

63. Worku S, Derbie A, Mekonnen D, Biadglegne F. Treatment outcomes of tuberculosis patients under directly observed treatment short-course at Debre Tabor General Hospital, northwest Ethiopia: Nine-years retrospective study. Infect Dis Poverty. 2018 Feb;7(1):16.

64. Nakanwagi-Mukwaya A, Reid AJ, Fujiwara PI, Mugabe F, Kosgei RJ, Tayler-Smith K, et al. Characteristics and treatment outcomes of tuberculosis retreatment cases in three regional hospitals, Uganda. Public Heal Action. 2013 Jun;3(2):149–55.

65. Takarinda KC, Harries AD, Srinath S, Mutasa-Apollo T, Sandy C, Mugurungi O. Treatment outcomes of new adult tuberculosis patients in relation to HIV status in Zimbabwe. Public Heal Action. 2011 Oct;1(2):34–9.

66. Ukwaja K, Ifebunandu N, … PO-TN, 2013 undefined. Tuberculosis treatment outcome and its determinants in a tertiary care setting in south-eastern Nigeria. europepmc.org.

67. World Health Organisation. Tuberculosis country profiles (Ghana). 2020.

68. Floyd K, Fitzpatrick C, Pantoja A, Raviglione M. Domestic and donor financing for tuberculosis care and control in low-income and middle-income countries: An analysis of trends, 2002-11, and requirements to meet 2015 targets. Lancet Glob Heal. 2013 Aug 1;1(2):e105–15.

69. WHO. The World Health Organization Report 2002: reducing risks, promoting healthy life. WHO Libr Cat Publ Data. 2002;232.

70. UNDP Evaluation Office. Handbook on Monitoring and Evaluating for Results. 2002.

71. Bonsu F, Hanson-Nortey N, Afutu F, Dzata F, Ahiabu M, Chimzizi R, et al. The National Tuberculosis Health Sector Strategic Plan for Ghana 2015-2020. 2014.

72. CCM Ghana. CCM Ghana - Tuberculosis. 2020.

73. CDC. Ghana Country Profile [Internet]. 2019 [cited 2020 May 12]. Available from: https://www.cdc.gov/globalhivtb/where-we-work/region/westafrica/ghana/ghana.html

74. Ghana National TB Control Programme. About Us | National TB Programe. 2016.

75. Ghana Health Service. Tuberculosis control programme | Ghana Health Service. 2017.

76. Ghana Health Service. Implementation of TB/HIV Collaborative Activities in Ghana : Joint Programme Planning Policy and Guidelines. Accra; 2014.

77. World Health Organization W. System screening for active tuberculosis: an operational guide. Geneva, Switz. 2015;(WHO/HTM/TB/2015.16).

78. Saunders MJ, Tovar MA, Collier D, Baldwin MR, Montoya R, Valencia TR, et al. Active and passive case-finding in tuberculosis-affected households in Peru: a 10-year prospective cohort study. Lancet Infect Dis. 2019 May 1;19(5):519–28.

79. Ghana Health Service. Implementation Plan for Isoniazid Preventive Therapy in Ghana. 2017.

80. World Health Organization . Global Tuberculosis Report 2018. 2018.

81. Oonyu L, Kang S, Konlan KD, Ae Kang Y. Isoniazid Preventive Therapy for Tuberculosis in People Living with HIV: A Cross Sectional Study in Butebo, Uganda. Infect Chemother. 2022;54(1):70–9.

82. Ghana NACP. Ghana HIV Sentinel Survey - Google Search. 2015.

83. Osei E, Der J, Owusu R, Kofie P, Axame WK. The burden of HIV on Tuberculosis patients in the Volta region of Ghana from 2012 to 2015: Implication for Tuberculosis control. BMC Infect Dis. 2017;17(1):1–9.

84. World Health Organization W. World Health Organization (Who) Country Office for Ghana Annual Report 2015. World Heal Organ (Who) Ctry Off Ghana Annu Rep. 2016;3(May):N0.2.

85. Helfrich CD, Weiner BJ, Mckinney MM, Minasian L. Determinants of Implementation Effectiveness. 2007;279–303.

86. James Bell A. Evaluation Brief: Measuring Implementation Fidelity. James Bell Assoc. 2009;(October):1–6.

87. Frank JC, Coviak CP, Healy TC, Belza B, Casado BL, Frank JC;, et al. Addressing Fidelity in Evidence-Based Health Promotion Programs for Older Adults. 2008;17.

88. Schmidt B, Watt K, McDermott R, Mills J. Assessing the link between implementation fidelity and health outcomes for a trial of intensive case management by community health workers: A mixed methods study protocol. BMC Health Serv Res. 2017 Jul;17(1):490.

89. Dane A V., Schneider BH. Program integrity in primary and early secondary

prevention: Are implementation effects out of control? Clin Psychol Rev. 1998 Jan;18(1):23–45.

90. Hasson H. Systematic evaluation of implementation fidelity of complex interventions in health and social care. Implement Sci. 2010 Sep 3;5(1):67.

91. Breitenstein SM, Gross D, Garvey CA, Hill C, Fogg L, Resnick B. Implementation fidelity in community-based interventions. Res Nurs Heal. 2010 Apr;33(2):164–73.

92. Lebina L, Alaba O, Ringane A, Hlongwane K, Pule P, Oni T, et al. Process evaluation of implementation fidelity of the integrated chronic disease management model in two districts, South Africa. BMC Health Serv Res. 2019 Dec 16;19(1):1–14.

93. Fisher R, Smith K, Finney S, Pinder K. The Importance of Implementation Fidelity Data for Evaluating Program Effectiveness. About Campus. 2014;19(5):28–32.

94. Nurjono M, Shrestha P, Ang IYH, Shiraz F, Yoong JSY, Toh SAES, et al. Implementation fidelity of a strategy to integrate service delivery: learnings from a transitional care program for individuals with complex needs in Singapore. BMC Health Serv Res. 2019 Mar 19;19(1):177.

95. Pérez D, Van der Stuyft P, Del M, Zabala C, Castro M, Lefèvre P, et al. A modified theoretical framework to assess implementation fidelity of adaptive public health interventions. Implement Sci. 2016 Jul;11(1):91.

96. Breitenstein SM, Fogg L, Garvey C, Hill C, Resnick B, Gross D. Measuring Implementation Fidelity in a Community-Based Parenting Intervention. Nurs Res. 2010 May;59(3):158–65.

97. Clark A, Breitenstein S, Martsolf DS, Winstanley EL. Assessing Fidelity of a Community-Based Opioid Overdose Prevention Program: Modification of the Fidelity Checklist. J Nurs Scholarsh. 2016 Jul;48(4):371–7.

98. Barron L. The SAGE Dictionary of Social Research Methods: Validity of Measurement. SAGE Dict Soc Res Methods. 2006 Jul 15;163–4.

99. Jupp V. Self-Report Study. In: The SAGE Dictionary of Social Research Methods. SAGE Publications, Ltd; 2015.

100. Davidson J. Non-probability (non-random) sampling. In: Jupp V, editor. The SAGE dictionary of social research methods. London, UK: Sage; 2006. p. 197–8.

101. Mowbray CT, Holter MC, Teague GB, Bybee D. Fidelity criteria: Development, measurement, and validation. Am J Eval. 2003 Sep 30;24(3):315–40.

102. World Health Organization. Global tuberculosis report 2015. Geneva, Switzerland; 2015.

103. Owiti P, Onyango D, Momanyi R, Harries AD. Screening and testing for tuberculosis among the HIV-infected: Outcomes from a large HIV programme in western Kenya 11 Medical and Health Sciences 1117 Public Health and Health Services 11 Medical and Health Sciences 1103 Clinical Sciences. BMC Public Health. 2019 Jan 8;19(1):29.

104. Becker DR, Smith J, Tanzman B, Drake RE, Tremblay T. Fidelity of supported employment programs and employment outcomes. Psychiatr Serv. 2001;52(6):834–6.

105. Hernandez M, Gomez A, Lipien L, Greenbaum PE, Armstrong KH, Gonzalez P. Use

of the System-of-Care Practice Review in the National Evaluation. J Emot Behav Disord. 2001 Jan 14;9(1):43–52.

106. Kelly JA, Heckman TG, Stevenson LY, Williams PN, Ertl T, Hays RB, et al. Transfer of research-based HIV prevention interventions to community service providers: fidelity and adaptation. undefined. 2000;

107. Abry T, Hulleman CS, Rimm-Kaufman SE. Using Indices of Fidelity to Intervention Core Components to Identify Program Active Ingredients. Am J Eval. 2015 Sep 6;36(3):320–38.

108. Hasson H, Blomberg S, Dunér A. Fidelity and moderating factors in complex interventions: a case study of a continuum of care program for frail elderly people in health and social care. Implement Sci. 2012 Mar 22;7(1):23.

109. Kok MSY, Jones M, Solomon-Moore E, Smith JR. Implementation fidelity of a voluntary sector-led diabetes education programme. Health Educ. 2018;118(1):62–81.

110. Mihalic S. The Importance of Implementation Fidelity. 2002.

111. Breitenstein SM, Gross D, Garvey CA, Hill C, Fogg L, Resnick B. Implementation fidelity in community-based interventions. Res Nurs Health. 2010 Apr;33(2):164–73.

112. Grol R, Dalhuijsen J, Thomas S, Rutten G, Bmj HM-, 1998 undefined. Attributes of clinical guidelines that influence use of guidelines in general practice: observational study. bmj.com.

113. Bellg AJ, Resnick B, Minicucci DS, Ogedegbe G, Ernst D, Borrelli B, et al. Enhancing treatment fidelity in health behavior change studies: Best practices and recommendations from the NIH Behavior Change Consortium. Vol. 23, Health Psychology. 2004. p. 443–51.

114. Faw L, Hogue A, Liddle HA. Multidimensional Implementation Evaluation of a Residential Treatment Program for Adolescent Substance Abuse. Am J Eval. 2005 Mar;26(1):77–94.

115. Powell RA, Kaye RM, Ddungu H, Mwangi-Powell F. Advancing drug availability - Experiences from Africa. J Pain Symptom Manage. 2010 Jul;40(1):9–12.

116. Mubyazi GM, Magnussen P, Goodman C, Bygbjerg IC, Olsen OE, Byskov J, et al. Implementing Intermittent Preventive Treatment for Malaria in Pregnancy: Review of Prospects, Achievements, Challenges and Agenda for Research. Open Trop Med J. 2008;1(1):92–100.

117. Nilsen P, Bernhardsson S. Context matters in implementation science: A scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. Vol. 19, BMC Health Services Research. BioMed Central Ltd.; 2019. p. 189.

118. Grol R, Wensing M. What drives change? Barriers to and incentives for achieving evidence-based practice. Med J Aust. 2004 Mar 15;180(6 SUPPL.).

119. Fleuren M, … KW-I journal for, 2004 undefined. Determinants of innovation within health care organizations: literature review and Delphi study. academic.oup.com.

120. Feldstein A, and RG-TJCJ on Q, 2008 undefined. A practical, robust implementation

and sustainability model (PRISM) for integrating research findings into practice. Elsevier.

121. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice : a consolidated framework for advancing implementation science. 2009;15:1–15.

122. Flottorp SA, Oxman AD, Krause J, Musila NR, Wensing M, Godycki-Cwirko M, et al. A checklist for identifying determinants of practice: A systematic review and synthesis of frameworks and taxonomies of factors that prevent or enable improvements in healthcare professional practice. Vol. 8, Implementation Science. 2013.

123. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: Systematic review and recommendations. Vol. 82, Milbank Quarterly. 2004. p. 581–629.

124. Fixsen D, Naoom S, Blase K, Friedman R. Implementation research: A synthesis of the literature. 2005;

125. Blase, KA; Van Dyke, M; Fixsen,DL; Bailey F. Implementation Science: Key Concepts, Themes, and Evidence for Practitioners in Educational Psychology | FPG Child Development Institute. Kelly, B; Perkins D, editor. Handbook of implementatio science for psychology in education. Cambridge: Cambridge University Press. Cambridge; 2012. 13–34 p.

126. Nutley S, Walter I, Davies H. Using evidence: How research can inform public services. 2007.

127. Thorsen T, Mäkelä M. Changing professional practice: theory and practice of clinical guidelines implementation. 1999;

128. Wensing M, Amargos-Bosch M, Foy R, Weijden T. Factors in theories on behaviour change to guide implementation and quality improvement in healthcare. 2005;

129. Rainbird K, Sanson-Fisher R, Buchan H. Identifying barriers to evidence uptake. 2006;

130. Cochrane LJ, Olson CA, Murray S, Dupuis M, Tooman T, Hayes S. Gaps between knowing and doing: Understanding and assessing the barriers to optimal health care. J Contin Educ Health Prof. 2007 Mar;27(2):94–102.

131. Gurses A, Marsteller J, Ozok A, … YX-C care, 2010 undefined. Using an interdisciplinary approach to identify factors that affect clinicians' compliance with evidence-based guidelines. journals.lww.com.

132. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. Implement Sci. 2012 Apr 24;7(1).

133. Harvey G, Kitson A. PARIHS revisited: From heuristic to integrated framework for the successful implementation of knowledge into practice. Implement Sci. 2016 Mar 10;11(1).

134. Kirk MA, Kelley C, Yankey N, Birken SA, Abadie B, Damschroder L. A systematic review of the use of the Consolidated Framework for Implementation Research. Vol. 11, Implementation Science. BioMed Central Ltd.; 2016.

135. Keith RE, Crosson JC, O'Malley AS, Cromp D, Taylor EF. Using the Consolidated Framework for Implementation Research (CFIR) to produce actionable findings: a rapid-cycle evaluation approach to improving implementation. Implement Sci. 2017 Dec 10;12(1):15.

136. Biermann O, Lönnroth K, Caws M, Viney K. Factors influencing active tuberculosis case-finding policy development and implementation: A scoping review. BMJ Open. 2019 Dec 11;9(12):e031284.

137. Dunbar NK. Analysis of factors that influence early tuberculosis case detection Analysis of factors that influence early tuberculosis case detection among aged 15 years and above in Liberia. 2013.

138. Dabaro D. Factors affecting tuberculosis case detection in Kersa District, South West Ethiopia. J Clin Tuberc Other Mycobact Dis. 2017 Dec 1;9:1–4.

139. Insurance Daily News. Studies from Karolinska Institute Have Provided New Data on Tuberculosis (Factors influencing active tuberculosis case-finding policy development and implementation: a scoping review) - InsuranceNewsNet [Internet]. [cited 2020 May 28]. Available from: https://insurancenewsnet.com/oarticle/studies-from-karolinska-institute-have-provided-new-data-on-tuberculosis-factors-influencing-active-tuberculosis-case-finding-policy-development-and-implementation-a-scoping-review#.Xs8SzmgzaM8

140. Ahorlu CK, Bonsu F. Factors affecting TB case detection and treatment in the Sissala East District, Ghana. J Tuberc Res. 2013;01(03):29–36.

141. Afoakwaa E, Taylorb J. Knowledge of tuberculosis and factors responsible for low case detection in the Amansie Central District, Ghana. South Sudan Med J. 2018 Feb;11(1).

142. Amenuvegbe GK, Francis A, Fred B. Low tuberculosis case detection: a community and health facility based study of contributory factors in the Nkwanta South district of Ghana. BMC Res Notes. 2016 Dec 29;9(1):330.

143. Fernandez ME, Walker TJ, Weiner BJ, Calo WA, Liang S, Risendal B, et al. Developing measures to assess constructs from the Inner Setting domain of the Consolidated Framework for Implementation Research. Implement Sci. 2018 Mar 27;13(1):52.

144. VanDevanter N, Kumar P, Nguyen N, Nguyen L, Nguyen T, Stillman F, et al. Application of the Consolidated Framework for Implementation Research to assess factors that may influence implementation of tobacco use treatment guidelines in the Viet Nam public health care delivery system. Implement Sci. 2017 Dec 28;12(1):27.

145. City-Population. Ghana: Administrative Division (Regions and Districts) - Population Statistics, Charts and Map [Internet]. 2019 [cited 2020 Jun 8]. Available from: https://www.citypopulation.de/en/ghana/admin/

146. Martínez-Mesa J, González-Chica DA, Duquia RP, Bonamigo RR, Bastos JL. Sampling: How to select participants in my research study? An Bras Dermatol. 2016 May 1;91(3):326–30.

147. StataCorp. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC. 2017.

148. Shwartz M, Restuccia JD, Rosen AK. Composite Measures of Health Care Provider Performance: A Description ofApproaches. Milbank Q. 2015 Dec 1;93(4):788.

149. Smith J, Firth J. Qualitative data analysis: the framework approach. Nurse Res. 2011 Jan 21;18(2):52–62.

150. Dapaah JM, Spronk R. When the clinic becomes a home. Successful VCT and ART services in a stressful environment. SAHARA J J Soc Asp HIV/AIDS Res Alliance. 2016 Sep 6;13(1):142.

151. Owusu AY. A gendered analysis of living with HIV/AIDS in the Eastern Region of Ghana. BMC Public Health. 2020 May 24;20(1):1–15.

152. Boateng SA, Kodama T, Tachibana T, Hyoi N. ＜ Original ＞ Factors Contributing to Tuberculosis (TB) Defaulter Rate in New Juaben Municipality in the Eastern Region of Ghana. 2010;59:291–7.

153. Sabasaba A, Mwambi H, Somi G, Ramadhani A, Mahande MJ. Effect of isoniazid preventive therapy on tuberculosis incidence and associated risk factors among HIV infected adults in Tanzania: A retrospective cohort study 11 Medical and Health Sciences 1117 Public Health and Health Services. BMC Infect Dis. 2019 Jan 17;19(1):1–8.

154. Karanja M, Kingwara L, Owiti P, Kirui E, Ngari F, Kiplimo R, et al. Outcomes of isoniazid preventive therapy among people living with HIV in Kenya: A retrospective study of routine health care data. PLoS One. 2020 Dec 1;15(12):e0234588.

155. Teklay G, Teklu T, Legesse B, Tedla K, Klinkenberg E. Barriers in the implementation of isoniazid preventive therapy for people living with HIV in Northern Ethiopia: a mixed quantitative and qualitative study. 2016;

156. Maharaj B, Gengiah TN, Yende-Zuma N, Gengiah S, Naidoo A, Naidoo K. Implementing Isoniazid Preventive Therapy in a TB-treatment experienced cohort on ART. Int J Tuberc Lung Dis. 2017 May 1;21(5):537.

157. Kalafat J, Illback RJ, Sanders D. The relationship between implementation fidelity and educational outcomes in a school-based family support program: development of a model for evaluating multidimensional full-service programs. Eval Program Plann. 2007 May;30(2):136–48.

158. Loflin JW. Relationship Between Teacher Fidelity and Physical Education Student Outcomes. Phys Educ. 2015;

159. Becker W, Saisana M, Paruolo P, Vandecasteele I. Weights and importance in composite indicators: Closing the gap. Ecol Indic. 2017 Sep 1;80:12–22.

160. Kumah E, Ankomah SE, Fusheini A, Sarpong EK, Anyimadu E, Quist A, et al. Frameworks for health systems performance assessment: how comprehensive is Ghana's holistic assessment tool? Glob Heal Res Policy. 2020 Dec 1;5(1):1–12.

161. Taibanguay N, Chaiamnuay S, Asavatanabodee P, Narongroeknawin P. Effect of patient education on medication adherence of patients with rheumatoid arthritis: a randomized controlled trial. Patient Prefer Adherence. 2019;13:119.

162. Knight J, Wachira J, Kafu C, Braitstein P, Wilson IB, Harrison A, et al. The Role of Gender in Patient-Provider Relationships: A Qualitative Analysis of HIV Care

Providers in Western Kenya with Implications for Retention in Care. AIDS Behav. 2019 Feb 15;23(2):395.

163. Slade SC, Kent P, Bucknall T, Molloy E, Patel S, Buchbinder R. Barriers to primary care clinician adherence to clinical guidelines for the management of low back pain: protocol of a systematic review and meta-synthesis of qualitative studies. BMJ Open. 2015 Apr 1;5(4):e007265.

164. Simegn BK, Chelkeba L, Alamirew BD. Clinicians' prescribing pattern, rate of patients' medication adherence and its determinants among adult hypertensive patients at Jimma University Medical Center: Prospective cohort study. PLoS One. 2021 Nov 1;16(11):e0259421.

165. Grimshaw J, Freemantle N, Wallace S, Russell I, Hurwitz B, Watt I, et al. Developing and implementing clinical practice guidelines. Vol. 4, Quality in health care : QHC. BMJ Publishing Group; 1995. p. 55–64.

166. Wang Z, Norris SL, Bero L. Implementation plans included in World Health Organisation guidelines. Implement Sci. 2016 May 20;11(1):76.

167. Nansera D, Bajunirwe F, Kabakyenga J, Asiimwe PKJ, Mayanja-Kizza H. Opportunities and barriers for implementation of integrated TB and HIV care in lower level health units: Experiences from a rural western Ugandan district. Afr Health Sci. 2010;10(4):312–9.

168. Cofie P, De Allegri M, Kouyaté B, Sauerborn R. Effects of information, education, and communication campaign on a community-based health insurance scheme in Burkina Faso. Glob Health Action. 2013;6:20791.

169. Toomey E, Currie-Murphy L, Matthews J, Hurley DA. Implementation fidelity of physiotherapist-delivered group education and exercise interventions to promote self-management in people with osteoarthritis and chronic low back pain: a rapid review part II. Man Ther. 2015 Apr 1;20(2):287–94.

170. Elouafkaoui P, Young L, Newlands R, Duncan EM, Elders A, Clarkson JE, et al. An Audit and Feedback Intervention for Reducing Antibiotic Prescribing in General Dental Practice: The RAPiD Cluster Randomised Controlled Trial. PLoS Med. 2016 Aug 1;13(8).

171. Palmer NAO. Can audit improve antibiotic prescribing in general dental practice? Br Dent J. 2001;191(5):253–5.

172. Villarosa AR, Maneze D, Ramjan LM, Srinivas R, Camilleri M, George A. The effectiveness of guideline implementation strategies in the dental setting: A systematic review. Vol. 14, Implementation Science. BioMed Central Ltd.; 2019. p. 106.

173. May C, Finch T, Mair F, Ballini L, Dowrick C, Eccles M, et al. Understanding the implementation of complex interventions in health care: The normalization process model. BMC Health Serv Res. 2007 Sep 19;7(1):1–7.

174. Wagner TH, Yoon J, Jacobs JC, So A, Kilbourne AM, Yu W, et al. Estimating Costs of an Implementation Intervention. Med Decis Making. 2020 Nov 1;40(8):959–67.

175. Marshall WL, Marshall LE. Psychological Treatment of Sex Offenders. Recent Innovations. Vol. 37, Psychiatric Clinics of North America. W.B. Saunders; 2014. p. 163–71.

176. Ayakaka I, Ackerman S, Ggita JM, Kajubi P, Dowdy D, Haberer JE, et al. Identifying barriers to and facilitators of tuberculosis contact investigation in Kampala, Uganda: A behavioral approach. Implement Sci. 2017;12(1):1–13.

177. Sekhon M, Cartwright M, Francis JJ. Acceptability of healthcare interventions: An overview of reviews and development of a theoretical framework. BMC Health Serv Res. 2017 Jan 26;17(1):1–13.

178. Cooper C, O'Cathain A, Hind D, Adamson J, Lawton J, Baird W. Conducting qualitative research within Clinical Trials Units: avoiding potential pitfalls. Contemp Clin Trials. 2014;38(2):338–43.

Appendices

Appendix A: Original paper 1

PLOS ONE

RESEARCH ARTICLE

Fidelity of implementation of TB screening guidelines by health providers at selected HIV clinics in Ghana

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Abstract

Introduction

Tuberculosis screening of people living with human immunodeficiency virus is an intervention recommended by the WHO to control the dual epidemic of TB and HIV. The extent to which the intervention is adhered to by the HIV healthcare providers (fidelity) determines the intervention's effectiveness as measured by patient outcomes, but literature on fidelity is scarce. This study assessed provider implementation fidelity to national guidelines on TB screening at HIV clinics in Ghana.

Methods

It was a cross-sectional study that used structured questionnaires to gather data, involving 226 of 243 HIV healthcare providers in 27 HIV clinics across Ghana. The overall fidelity score comprised sixteen items with a maximum score of 48 grouped into three components of the screening intervention (TB diagnosis, TB awareness and TB symptoms questionnaire). Simple summation of item scores was done to determine fidelity score per provider. In this paper, we define the level of fidelity as low if the scores were below the median score and were otherwise categorized as high. Background factors potentially associated with implementation fidelity level were assessed using cluster-based logistic regression. Odds ratio with 95% confidence interval (CI) was used as the measure of association.

Results

Of the 226 healthcare providers interviewed, 60% (135) were females with a mean age of 34.5 years (SD = 8.3). Most of them were clinicians [63% (142)] and had post-secondary non-tertiary education [62% (141)]. Overall, 53% (119) of the healthcare providers were categorized to have implemented the intervention with high fidelity. Also, 56% (126), 53% (120), and 59% (134) of the providers implemented the TB diagnosis, TB awareness and

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TB symptoms questionnaire components respectively with high fidelity. After adjusting for cluster effect, female providers (AOR = 2.38, 95%CI: 1.09–5.10, p = <0.029), those with tertiary education (AOR = 4.31, 95%CI: 2.12–9.10, p = 0.040), and clinicians (AOR = 1.78, 95%CI: 1.07–3.60, p = 0.045) were more likely to adhere to the guidelines compared to their counterparts.

Conclusion

The number of providers with fidelity scores above the median was marginally greater (6%) than the number with fidelity score below the median. Similarly, for each of the components, the number of providers with fidelity scores higher than the median was marginally higher. This could explain the existing fluctuations in the intervention outcomes in Ghana. We found gender, profession and education were associated with provider implementation fidelity. To improve fidelity level among HIV healthcare providers, and realize the aims of the TB screening intervention among PLHIV in Ghana, further training on implementing all components of the intervention is critical.

Introduction

Globally, tuberculosis (TB) disease is known to be the main cause of death among people living with HIV (PLHIV) [1]. PLHIV are more likely to succumb to TB diseases than people without HIV due to their compromised immune system. Intensified TB case-finding through TB screening of PLHIV is one of the World Health Organization (WHO) policies emphasizing TB and HIV collaborative activities as a means to reducing the dual burden of TB and HIV [2, 3]. Effective TB screening of PLHIV ensures early identification of those with presumptive TB infection who requires a confirmatory test through X-ray or genXpert for appropriate treatment [1]. The early detection helps to identify TB cases and ensures the separation of cases from non-cases to reduce the TB transmission in PLHIV [1].

The National TB Control Programme (NTP) in Ghana, like many other countries where HIV and TB are of public health concern, adopted and implemented the policy on TB screening of PLHIV in 2004 [2, 4]. PLHIV who attend HIV clinics should be systematically and routinely screened for TB at every visit using the WHO-approved screening questionnaire for the presence of cough of any duration, fever, weight loss and night sweats [5]. PLHIV with the presence of one or more of these symptoms have a confirmatory test (X-ray/XpertMTB/RIF) and then appropriate preventive or curative treatment depending on the result [3]. Although the intervention (TB screening of PLHIV) was implemented over a decade ago [6] the proportion of PLHIV screened had not been stable–declines and fluctuates over time [7]. In the early years of the implementation, the proportion of PLHIV screened for TB was about 70–96% [7]. But this fluctuated as the years progressed, with about 80% of PLHIV in 2013 [7] and 41% in 2014 [8] not screened for TB. This led to a review of the policy in 2014 with new screening targets set at 56% for 2015, and progressively increasing the target to 80% in 2018 and 90% in 2020 [7]. In 2018, 44000 TB cases and 15,800 TB deaths were recorded with an estimated incidence rate of 148 per 100,000 population [9]. Also, according to the WHO global TB report (2020) [10] out of 95,434 newly enrolled person in HIV care in Ghana, 2020 (7.4%) were notified as TB cases.

Intervention implementation under real-life conditions is known to be complex and influenced by different factors [11–13]. The implementation science (IS) literature posits that interventions of proven effectiveness may fail to yield intended outcomes due to challenges related to the implementation of the intervention in real-world settings [14–17].

Some researchers postulate that interventions yield the desired outcome if the implementation is effective [17–19]. One of the ways to measure implementation effectiveness is to assess what is referred to in IS as implementation fidelity (IF) (that is the degree to which the intervention is being implemented by healthcare providers as intended by the designers of the intervention) [20–24]. Some researchers have conceptualised how different factors act or interplay to influence the implementation programme [12, 14–16, 25, 26]. Carroll et al. 2007 [24] developed a comprehensive framework outlining the components of implementation fidelity as adherence covering activities of content, coverage, frequency and duration. It also outlined that the level of implementation fidelity may be influenced by factors called moderators subcategorised as intervention complexity, facilitation strategies quality of delivery, and participant's responsiveness. They emphasised that IF is the same as adherence and so therefore, the assessment of IF is tantamount to adherence assessment. It is argued that any of these fidelity components alone, or a mix depending on the intervention and the guidelines, could be used to measure implementation fidelity [21, 27]. But the mix must show consistency in dimensionality (number of attributes of a dataset for an outcome), reliability (produce the same finding under similar situation) and validity (measures what it is intended to) through the use of an empirical method of analysis such as structural equation modelling, factor analysis and principal component analysis [28, 29], summation of items/activities/component scores [30]. These analytic techniques are helpful to researchers in determining the best combination of items. Interventions are aided with policy or programme guidelines based on both theoretical and empirical grounds. These guidelines contain the core components of the intervention without which the intervention cannot operate effectively to achieve the intended outcome [31, 32].

Many studies have been conducted on IF from different disciplines [33]; in education [34], social work [35], engineering [36], construction [37] and health [16, 38, 39], the area of this study. IF is important in the process of translating evidence-based interventions into real-life practice. This means, whether an intervention is implemented within the health sector according to design, for instance, has repercussions on whether that intervention will achieve in the population the health outcomes observed in the clinical trials [15, 19]. However, there is a dearth of research on the fidelity of implementation of the TB screening intervention among PLHIV in Ghana or elsewhere. Most studies conducted in this area are focused on screening coverage [40–42]. Another one was a before-and-after study that assessed the impact of integrating TB and HIV services on TB treatment outcomes and explored the usefulness of TB treatment outcomes as TB/HIV indicators [43]. Whether and the extent to which the TB screening intervention among PLHIV is being implemented would have an impact on the coverage of this intervention among PLHIV (service outcome) and ultimately the burden of TB among PLHIV (health outcome). However, no study has been conducted in Ghana to assess IF as a possible reason for the observed low and fluctuating screening coverage outcomes since the implementation of the intervention. This study, therefore, assessed the level of provider IF to TB screening among PLHIV attending HIV clinics in Ghana as well as factors associated with IF level.

Conceptual framework: The conceptual framework for implementation fidelity

Many frameworks have been developed for assessing IF. Where applicable, some studies combine adherence and competence to assess IF [38, 44, 45] while other studies assessed only

adherence and consider competence as a moderating factor [46, 47]. Having identified adherence as our focus of assessing IF for this study, we adapted Carroll et al. Conceptual Framework for Implementation Fidelity (CFIF) [24] because it harnessed other frameworks and is a comprehensive and useful way of assessing IF [12]. Carroll et al. [24] reviewed existing theories and frameworks of IF and developed the CFIF with constructs guiding the assessment and understanding of implementation fidelity. The framework was made up of five elements; adherence, dose, quality of delivery, participant responsiveness, and programme differentiation. The framework suggested that the measurement of adherence (content, frequency, duration and coverage) to the intervention is IF. It considers the rest of the elements as moderating factors of fidelity level achieved. The desired outcome of TB screening depends largely on how well the intervention is implemented. The final implementers of the intervention were the providers at the HIV clinics.

We, therefore, adapted and drew conceptual inspiration from CFIF to assess IF for this study at the provider level. According to Carroll et al. [24], successful implementation can only result if the essential components of the intervention are identified and implemented as planned. The identification offers the opportunity for adaptation. Clinical guidelines outlining what the healthcare providers are expected to do in terms of TB screening among PLHIV exist [2, 3, 7]. In adapting the CFIF to measure IF, we reviewed the TB screening guideline among PLHIV and identified essential components. These components were grouped under content and frequency sub-constructs of adherence.

The level of IF is influenced by the relationship between other factors and the essential components of the intervention identified. In our study, the IF could potentially be influenced by an interaction between these essential components and critical characteristics such as contextual factors (regional location of the HIV clinic) and the provider characteristics. They are widely considered critical because they influence attitude and motivation which eventually affects behaviour. Based on the concept of the framework, we finally decided to examine the influence of these critical characteristics on IF as depicted in Fig 1. The broken line in Fig 1 shows that the connection between TB screening among PLHIV and its outcomes is external to IF, but that the degree of IF attained can alter this relationship.

The details of content and frequency sub-constructs used in this study are defined as below:

1. Content–the degree to which healthcare providers at the HIV clinic follow the intervention guideline, e.g. providing important counselling and education, screening, referral, and appropriate treatment
2. Frequency–the extent to which healthcare providers at the HIV clinic perform the activities on the guideline according to the prescribed frequency, e.g. how often does the HIV care provider conducts counselling, education, use the TB screening tools among PLHIV; which must be conducted all the time for all clients seen.

Materials and methods

Ethics statement

Protocol approvals were obtained from both the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg, South Africa (Clearance number M190118) and the Ghana Health Service Ethical Review Committee (GHS-ERC), Accra, Ghana (clearance number GHS–ERC002/01/19). All participants in the study gave written consent.

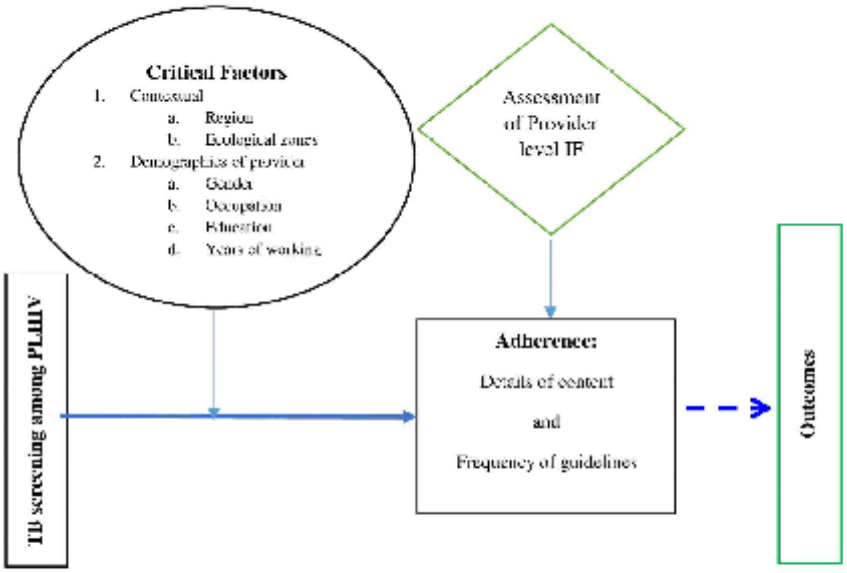

Fig 1. A conceptual framework for provider level IF to TB screening at HIV clinics in Ghana Adapted from CFIF by Carroll et al., 2007.

https://doi.org/10.1371/journal.pone.0257499.g001

Study site

Ghana administratively is made up of 10 regions subdivided into 216 districts in 2017. Out of the 216 districts, 140 have district hospitals. This study was conducted in 27 HIV clinics located within 27 district hospitals across the 10 regions. These 27 district hospitals have and mandatorily run HIV clinics daily on all the 5-working days of the week. These district hospitals were chosen for this study because as part of care, the NTP identified these 27 district hospitals with both X-ray machines and geneXperts for TB confirmatory tests as the first sites to begin the implementation of Isoniazid preventive therapy (IPT) for screened PLHIV who tested negative for TB.

The regional distribution of these hospitals are Volta 1; Upper West, Northern, and Greater Accra with 2 each; Brong Ahafo, Central, Upper East and Western with 3 each and Eastern and Ashanti with 4 each as shown on the map of Ghana (Fig 2).

Among PLHIV, preventing TB involves the three Ts: Intensified case finding, Isoniazid Preventive Therapy (IPT), and Infection Control for TB including early initiation of ART. At the HIV clinic within the district hospital, trained healthcare providers (clinical and non-clinical) guided by the guidelines for TB preventive therapy in Ghana provide TB preventive services to PLHIV attending the clinic. At every visit, PLHIV are given TB counselling and screening using TB symptom screening questionnaire. Based on the client response to the signs and symptoms (cough of any duration, night sweat, chest pain, weight loss or fever) providers had to refer client to for GenXpert or X-rays confirmation test. If *Mycobacterium* TB is detected, providers initiate anti therapy appropriately, otherwise they initiate TB preventive therapy based on TB expert evaluation.

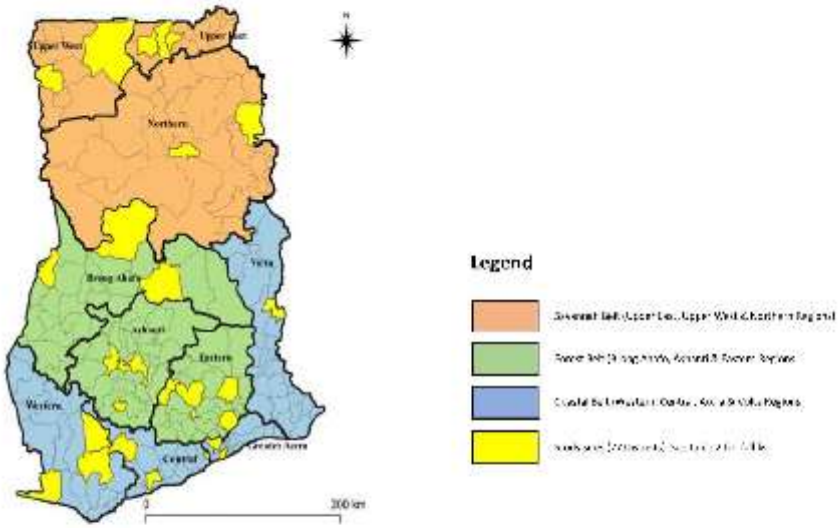

Fig 2. A map of Ghana showing the 10 regions and the study sites.

https://doi.org/10.1371/journal.pone.0257499.g002

Unlike other sectors like education, construction, and engineering, the health sector at the district hospital level (Fig 3) for instance had intervention guidelines for (1) management at facility or programme level and (2) providers who are the direct implementers of the interventions to participants. The structure in Fig 3 refers to the arrangement or formation at the hospital. All the providers at the HIV care clinics were equipped to screen PLHIV for TB. The NPT ensured that all HIV clinics staff had engaged in either a pre-service, in-service, and or continuing professional development and specialization course training on TB and HIV issues including TB screening. These providers include clinicians (provide direct care to patients, e.g. nurses and physicians) and non-clinicians (support patient care, e.g. disease control, task-shifting, health promotion, and nutrition officers). Therefore both the clinicians and non-clinicians at the HIV clinic trained on TB collaborative activities are required to provide TB and HIV counseling, conduct TB screening with the TB screening questionnaire, administer ARV, and provide other TB related activities among PLHIV at HIV clinics. Non-clinicians exclude

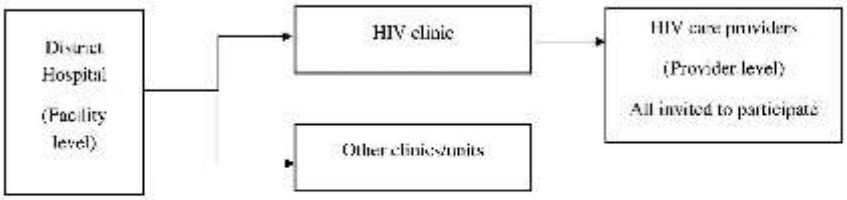

Fig 3. A typical structure of district hospital depicting where facility and provider levels belonged.

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laboratory and pharmacy staff who might have received trainings on TB related activities but do not do TB screening.

Study design and sampling

A total of 27 HIV clinics within the identified 27 district hospitals with both the X-ray machines and geneXperts for TB confirmatory tests were surveyed for the study.

The study was cross-sectional that used a census-based survey to interview all the providers at the 27 HIV care clinics. This census-based method was applied to achieve a good number of participants to conduct a meaningful analysis of the study. To maximise representation and ensure all providers involved in doing TB screening at the clinic participated in the study, the number of providers per clinic was established with an effort to include everyone in the study. Staff and other healthcare providers who did not work directly with the HIV clinic were excluded.

Data collection

A questionnaire was developed and used to collect data from the participants. The structured questionnaire collected data on the demographic characteristics of the provider, and data on their reported adherence to the clinical guidelines on screening of PLHIV, focusing on contents and frequency of the intervention implementation. Prior information and knowledge from the TB/HIV collaborative protocol guideline by the Ghana NTP [6] together with the CFIF guided the measurement approach. The provider-level fidelity questionnaire was developed based on the key elements or activities in the guidelines for the provision of TB screening among people living with HIV attending the HIV care clinic. The questionnaire focused on the main activities directly relating to TB screening by the providers, as documented in the guideline. A total of 19 questions were formulated from these main activities and as mentioned earlier was part of the pretest during the research assistants training.

As with many other healthcare surveys [48, 49], most of the questions were formulated on different point-Likert scales depending on what it sought to measure [50]. Table 1 presents a list of questions as outlined in the TB screening guideline and grouped under each of the content and frequency sub-elements and how they were measured.

Data collection was conducted by four teams of research assistants comprising three members each. Research assistants were trained for 5 days with the fifth day used for pretesting the tools. The tools were pretested in two similar HIV clinics to ensure that measurement errors and respondent burdens are minimized and to point out problem areas for rectification. The teams collected the main data only on weekdays from 9th April to 24th April 2019 (12 working days). Each team visited a facility for at least five working days. Follow-ups/return visits were made for 4-days while the team was still within the facility such that every participant could be interviewed. In the end, a total of 244 healthcare providers from the 27 district hospitals across the country were established as potential participants at the HIV clinics. We interviewed 226 participants, with the number of healthcare providers interviewed per clinic ranging from 6 to 12 as shown by the flowchart of the recruitment and study profile (Fig 4).

Data management and analysis

An EPIDATA version 3.1 software was use to capture the collected data which based on hard-copy questionnaire and further imported into Stata 15 for cleaning and analysis.

Questions covering content were measured by *1 = yes*, meaning the activity was performed or provided and *0 = no*, meaning the activity was not provided or performed. Other items under this construct were open-ended questions at the time of the data collection. They were

Table 1. List of the 19 items used to determine provider implementation fidelity score.

Content Items			Frequency Items	
Description (variable name)		Mean	Description (variable name)	Mean
Response:			Response:	
			1 = Never	
No. . ..0	Yes. . ..1		2 = Rarely	
			3 = For some clients sometimes	
			4 = Either for all new clients or annually for existing clients	
			5 = All the time for all clients	
Component 1: TB diagnosis				
Asks client about cough of any duration.		0.868	How frequently do ask PLHIV about cough of any duration during consultation?	4.317
Asks if the client has night sweats.		0.686	How frequently do you ask PLHIV about night sweats during consultation?	3.880
Asks if the client had fever.		0.619	How frequently do you ask PLHIV if they had a fever during consultation?	3.553
Asks if the client has pain in the chest.		0.748	How frequently do you ask PLHIV about pain in the chest during consultation?	3.838
Asks/checks if the client lost weight.		0.673	How frequently do you ask/check the weight of PLHIV during consultation?	3.736
Component 2: TB awareness				
Provides education.		0.699	How frequently do you provide education for PLHIV?	3.585
Provides counselling about TB screening.		0.726	How frequently do you provide counselling about TB screening for PLHIV?	3.681
Component 3: TB symptoms questionnaire				
Uses TB screening questionnaire (clinical algorithm).		0.750	How frequently do you use the TB screening questionnaire for PLHIV?	3.668
Component 4: TB screening process				
Do you ask all the HIV clients all the TB screening questions?		0.664		
After screening the client for TB, what do you do next? *				2.0
1 = No adherent 2 = Partially adherent 3 = fully adherent				
If you identify a client who you presumed of having TB, what steps would you take? *				1.680
1 = Not adherent 2 = Partially adherent 3 = fully adherent				

Note:

* Open-ended questions.

The means of each items were computed based on the responses from the providers to give prior information on each items prior to further analysis.

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post-coded later with a scale of 1 to 3 indicating the degree to which the provider's response reflected adherence to what is in the intervention guideline *(1 = not adherent; 2 = partially adherent and 3 = fully adherent)*. The frequency components of the questionnaire were measured on a scale of 1 to 5 *(1 = never, 2 = rarely, 3 = for some clients sometimes 4 = either for all new clients or annually for existing clients, 5 = All the time for all clients)*, with a scale 5 being what the intervention guidelines expected.

We first had to determine the level of implementation fidelity from the questions/items covering content and frequency and the further identify associated provider characteristics. The questionnaire items—which were selected from the guideline–had never been used to measure fidelity anywhere and as such, there was no reference for what would constitute high or low fidelity. There was therefore a need to identify the set of items or variables underlying the plausible factors or components required to measure provider implementation fidelity to the TB screening intervention guidelines. Since there was no existing study on how different items, number of items and components relate to one another to help us determine the fidelity level, we proceeded to arrive at a parsimonious representation of the associations among our

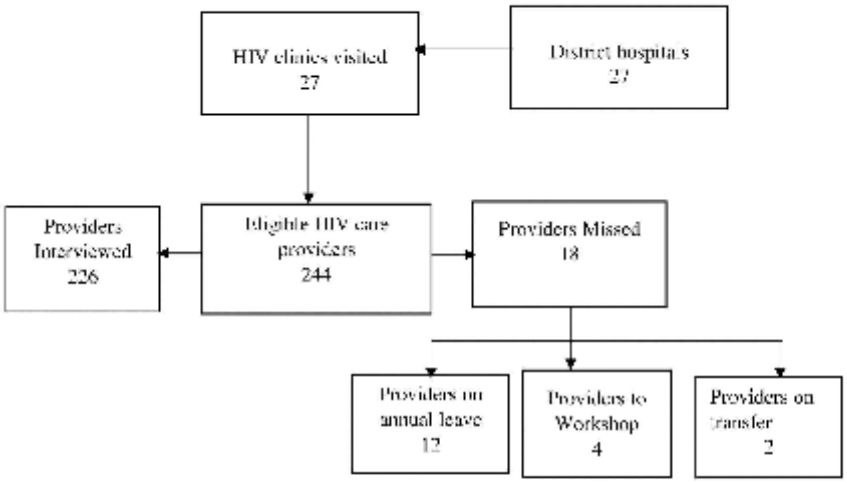

Fig 1. Flowchart of recruitment and study profile of the healthcare providers at the HIV clinics.

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measured variables. In order to do so and find the underlying variables for measuring fidelity to the guidelines on TB screening of PLHIV at HIV clinics, the exploratory factor analysis (EFA) method using polychoric correlations matrix technique was initially employed. On applying the EFA, we found that the factor loadings and unique variances were very low as expected but three of the 19 items. The factor analysis was however not value-adding as there was no apparent significant variable reduction. Therefore, the original items were instead used for further analysis.

As a result, we re-grouped the original items selected from the TB screening guideline into four main components based on our knowledge and experience. Each of the four components has different items that must be implemented to achieve the purpose of the TB screening intervention among PLHIV. These components are as follows:

1. *TB diagnosis* through screening for signs and symptoms of TB among all PLHIV at all HIV clinics during every visit.
2. *TB Awareness* through health education on TB and counselling of all HIV clients at every HIV clinic visit.
3. *TB symptoms questionnaire* to screen all HIV clients for TB at all HIV clinics.
4. *TB screening process* which entails providers' knowledge of the processes of early diagnosis and treatment of HIV-associated TB at the HIV clinic.

Each of the four components of the intervention is made up of between two to ten items as outlined in the guideline for implementation of TB/HIV collaborative activities [51]. Among the 19 items identified items, the TB diagnosis component comprises 10; TB awareness 4; TB symptoms questionnaire 2; and TB screening process 3 items.

To proceed with assessing the provider fidelity level, we conducted an internal consistency and reliability check to ensure that the various items are suitable to measure each of the four

components. The Cronbach Alpha which measures the internal consistency (the extent to which the items in a test measure the same component) of a scale [32] was used. A calculated alpha closer to one showed items measure the component well. The calculated alpha was high (approximately 0.900) for TB diagnosis, TB awareness, and TB symptoms questionnaire components except the TB screening process with an alpha score of 0.423. The TB screening process component was therefore excluded from the analysis based on it low alpha value [32]. The Cronbach Alpha calculated for all the items from the three components (TB diagnosis, TB awareness, and TB symptoms questionnaire) showed that the data seem to fit well (Alpha = 0.915) in the scale in all aspects to enhance the accuracy of overall provider fidelity level assessment.

We carried out the analysis on the three components and their respective items. Based on the various scoring for each item, the total maximum possible score was 48 (16 items) per provider (TB diagnosis 30; TB awareness 12; and TB symptoms questionnaire 6). Item scores for each component were summed to determine component-specific fidelity scores for each HIV care provider. An overall provider implementation fidelity level was then determined by summing items scores of all the three components.

The scores of the three components and the overall were converted to proportions based on the respective total maximum possible score and summarized using Median, Inter-quartile ranges (IQR), and percentages. These scores were measuring extent of fidelity and compared across geographic location of the health facility and provider characteristics using the Kruskal Wallis and Chi square tests.

Reference point regarding what constitutes a high level of provider implementation fidelity to TB screening among PLHIV is unknown. To aid interpretation of the fidelity scores, we arbitrarily used the median fidelity scores computed from this study as a cut-off, since our data was not normally distributed. Therefore we grouped as low fidelity those providers whose fidelity scores were below the median and as high fidelity those whose fidelity scores were equal or above the median fidelity (coded as *0 = low provider fidelity level* and *1 = high provider fidelity level*).

A descriptive analysis on the participants' characteristics and levels of fidelity was conducted. Logistic regression (LR) was used to examine for association between the IF level and characteristics of the healthcare provider adjusting for the district hospital (random) effect. Statistical significance was considered at 5% level. The variance inflation factor (VIF) calculated to measure the amount of multicollinearity in the regression variables ranged between 1.02 and 1.34 (mean VIF = 1.18), which indicates no correlation between the variables. All the analysis were performed using the Stata 15 software [33].

Results

Descriptive analysis

Characteristics of healthcare providers. The study profile (Fig 4) showed that 226 HIV care providers participated in this study. The result from descriptive analysis (Table 2) found that out of the 226 healthcare providers interviewed, about 60% (135) were females. The mean age of the providers was 34.5 years (Standard Deviation [SD] = 8.3) and 65% (147) providers have worked in the HIV clinic for less than 5 years. The results also showed that 63% (142) of the providers were clinicians whilst 62% (141) had attained a post-secondary non-tertiary level of education.

Among the clinicians, the mean age was 34.6 years (SD = 9.1), 76.8% (109) were females and most (76.1%, n = 108) had attained post-secondary non-tertiary education level followed by tertiary education (20.4%, n = 29). Also, among the non-clinicians, the mean age was 34.3

Table 2. Characteristics of the healthcare providers by profession at the HIV clinics in Ghana, 2019.

Characteristics of providers	Clinicians	Non-clinicians	All providers
	n (%)	n (%)	n (%)
Age in completed years, Mean (SD)	34.6 (9.1)	34.3 (7.0)	34.5 (8.3)
Gender			
Female	109 (76.8)	26 (38.9)	135 (59.7)
Male	33 (23.2)	38 (61.1)	91 (40.30)
Years working in HIV care clinic			
<5years	102 (71.8)	45 (23.6)	147 (65.0)
5years plus	40 (28.2)	39 (66.4)	79 (35.0)
Highest educational level			
Upper secondary	5 (3.5)	5 (5.9)	10 (4.4)
Post-secondary non-tertiary	108 (76.1)	33 (39.8)	141 (62.4)
Tertiary	29 (20.4)	46 (54.0)	75 (33.2)
Total	142 (100)	84 (100)	226 (100)

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years (SD = 7.0), most (69.1%n = 58) were males, and most (54.8%, n = 46) attained tertiary level of education followed by post-secondary no tertiary education (39.3%, n = 33).

Descriptive statistics of the raw items/variables. Table 3 presents the descriptive statistics for the raw data for determining implementation fidelity for the TB screening intervention. For example 79% (165) of the providers use the TB screening questionnaire at the HIV clinic during TB screening while 66% do ask all the HIV clients all the TB screening question during screening.

Provider implementation fidelity level

The study showed that, providers in 12 out of the 17 HIV clinics scored above the median implementation fidelity score. The results in Table 4 presents the summary statistics of provider fidelity scores for the three components of the intervention and the overall. The study showed that, the TB symptoms questionnaire component had the highest median score of 100% followed by TB diagnosis and TB awareness each scoring 83%.

The overall provider implementation fidelity score ranged from 16% to 100%. The median overall provider implementation score was 79% (IQR: 58.3, 100.0). Out of the 226 HIV care providers, 53% (n = 119) had scores above the median fidelity score.

The fidelity scores and levels for the three components were also compared.

TB diagnosis. The fidelity score for the component of TB diagnosis ranged from 17% to 100% with a median score of 83% (IQR: 50, 100). The study showed that about 56% (n = 126) of the HIV care providers had an implementation fidelity score above the TB diagnosis median score (high fidelity level). Providers in 16 clinics had a TB diagnosis implementation fidelity score above the median.

TB awareness. The result showed that, the fidelity score for the component of awareness also ranged from 17% to 100%. Its median fidelity score was also 83% (IQR: 50, 100) with about 53% (n = 120) of the health care providers scoring implementation fidelity above the median score of awareness component (high fidelity level). Provider in 13 clinics were found to have an awareness component fidelity score above the median.

TB symptoms questionnaire. The level of provider fidelity to implementing the TB screening questionnaire among PLHIV ranged from 17% to 100%, its median score was 100% (IQR: 17%, 100%), and most HIV care providers (59%, n = 134) were in high fidelity level category.

Table 3. Descriptive statistics of the fidelity assessment items among HIV healthcare providers at the HIV clinics in Ghana.

Items/Variables			N = 226, n (%)		
			No	Yes	
1. Asks client about cough of any duration.			31 (13.7)	195 (86.3)	
2. Asks if the client has night sweats.			71 (31.4)	155 (68.6)	
3. Asks if the client had fever.			86 (38.1)	140 (61.9)	
4. Asks if the client has pain in the chest.			57 (25.2)	169 (74.8)	
5. Asks/checks if the client lost weight.			74 (32.7)	152 (67.3)	
6. Provides education.			77 (34.1)	149 (65.9)	
7. Provides counselling about TB screening.			62 (27.4)	164 (72.6)	
8. Uses TB screening questionnaire (clinical algorithm).			61 (27.0)	165 (73.0)	
	Never	Rarely	Not across clients/ occasions	Either for all/some clients or occasionally for existing clients	All the times for all clients
9. How frequently do ask PLHIV about cough of any duration during consultation?	31 (13.7)	4 (1.8)	11 (4.9)	10 (4.4)	170 (75.2)
10. How frequently do you ask PLHIV about night sweats during consultation?	71 (31.4)	6 (2.7)	7 (3.1)	5 (2.2)	137 (60.6)
11. How frequently do you ask PLHIV if they had a fever during consultation?	86 (38.1)	6 (2.7)	7 (3.1)	5 (2.2)	122 (54.0)
12. How frequently do you ask PLHIV about pain in the chest during consultation?	57 (25.2)	7 (3.1)	6 (2.7)	5 (2.2)	151 (66.8)
13. How frequently do you ask/check the weight of PLHIV during consultation?	74 (32.7)	6 (2.7)	4(1.8)	5 (2.2)	137 (60.6)
14. How frequently do you provide education for PLHIV?	77 (34.1)	6 (2.6)	11 (4.9)	5 (2.2)	127 (56.2)
15. How frequently do you provide counselling about TB screening for PLHIV?	62 (27.4)	6 (2.7)	13 (5.7)	6 (2.7)	140 (61.9)
16. How frequently do you use the TB screening questionnaire for PLHIV?	61 (27.0)	2 (0.9)	22 (9.7)	7 (3.1)	134 (59.3)

Summary statistics note: The total number of interviews with healthcare providers is 226.

Table 4. Summary statistics of the provider fidelity scores by the components.

Component of the TB screening intervention	Fidelity score Median (IQR)	High fidelity level	Low fidelity level
		n (%)	n (%)
1. TB Diagnosis	83.33 (50, 100)	135 (55.8)	109 (44.2)
2. TB Awareness	84.33 (88, 100)	120 (49.1)	130 (46.9)
3. TB symptoms questionnaire	100 (16.67, 100)	154 (59.5)	93 (40.7)
Overall	79.17 (38.54, 100)	139 (52.7)	187 (47.3)

https://doi.org/10.1371/journal.pone.0257469.t004

Similarly, providers in 16 clinics were found to have an implementation fidelity score above the median for the TB diagnosis component.

Comparison of geographical and provider characteristics between fidelity levels. From the univariate analysis presented in Table 5, most healthcare providers in Brong Ahafo (70%), Western (88%), Greater Accra (60%), Northern (60%), and Volta (87%) regions were not adherent (low IF level) to the intervention guidelines compared to most providers in Ashanti (59%), Central (77%), Upper East (70%), Upper West (77%) and Eastern (55%) regions who implemented the intervention with high fidelity. Providers in Brong Ahafo, Western and Volta regions who were not adherent to the intervention guidelines differ significantly compared to their counterparts who were adherent to the intervention guidelines in some regions. Re-grouped regions into zones as a result of relatively small numbers did not showed statistically significant association between zonal locations and IF level–although providers in Savannah zone were about 1.6 times more likely to implement the intervention with high IF that those in the Forest zone.

Provider IF levels significantly ($p<0.05$) varied in terms of gender, profession, level of education attained (tertiary level) of the healthcare provider. The results show 61% of female providers had a high level of adherence to the TB screening intervention guidelines, as did 60% of clinician providers, 40% of non-clinician providers, 54% of healthcare providers who attained post-secondary non-tertiary education, and 53% of providers with tertiary education. Female providers were about 2.4 times more likely to adhere to implementation guidelines than male counterparts ($p<0.05$). Also, providers who attained post-secondary non-tertiary were about 3 times more likely to implement the intervention with high IF than those who attained upper secondary ($p<0.05$). The study found no significant difference in provider IF levels across educational age and the number of years working at the HIV clinic ($p>0.05$).

Factors associated with provider implementation fidelity level

We used the ecological zones in the multiple logistic regression instead of regions due to the small sample sizes and their potential effects on the confidence intervals. The cluster-based logistics regression result after adjusting for the district hospital as the cluster effect showed that gender, profession, and tertiary educational level of the HIV care provider were significantly associated with provider IF level (Table 6). After adjusting for other factors and the hospital effect, female providers were about 2.4 times (AOR = 2.36, 95% CI: 1.09–5.10, p = 0.029) more likely than their male counterparts to implement the TB screening intervention among PLHIV with high IF level.

The odds of being a clinician (AOR = 1.78, 95%CI: 1.07–3.50, p = 0.045), and attaining tertiary education level (AOR = 4.31, 95%CI: 2.12–9.10, p = 0.045) and implementing the intervention with high compliance is higher than being a non-clinician, and attaining upper secondary educational level after adjusting for other factors and hospital effect.

Table 3. Comparison of geographical and provider characteristics between fidelity levels.

Characteristics of providers	Low fidelity level	High fidelity level	Row Total	crude OR	95%CI
	N (%), M (SD)	N (%), M (SD)			
Region					
Ashanti (Ref)	13 (40.6)	19 (59.4)	32	1.00	-
Brong Ahafo	14 (70.0)	6 (30.0)	20	0.25*	0.09–0.86
Central	7 (22.6)	24 (77.4)	31	2.55	0.78–7.94
Eastern	19 (45.2)	23 (54.8)	42	0.82	0.33–2.10
Greater Accra	13 (60.0)	8 (40.0)	20	0.45	0.14–1.43
Northern	9 (60.0)	6 (40.0)	15	0.45	0.13–1.59
Upper East	6 (30.0)	14 (70.0)	20	1.50	0.49–5.24
Upper West	5 (20.1)	18 (76.9)	13	2.15	0.83–9.92
Volta	7 (87.5)	1 (12.5)	8	0.10*	0.01–0.69
Western	17 (65.0)	8 (31.0)	26	0.32*	0.11–0.96
Ecological zone					
Forest (*Brong Ahafo, Ashanti & Eastern*) (Ref)	46 (48.9)	48 (51.1)	94	1.00	-
Savannah (*Upper East, Upper West & Northern*)	18 (37.5)	30 (62.5)	48	1.60	0.78–3.29
Coastal (*GA Accra, Western, Central & Volta*)	48 (51.2)	41 (48.8)	84	0.91	0.51–1.63
Mean age of provider in completed years	33.8 (6.9)	36.3 (9.4)	-	1.03	0.98–1.09
Years working in HIV clinic					
<5years (Ref)	72 (49.0)	75 (51.0)	147	1.00	-
5years plus	35 (44.3)	44 (55.7)	79	1.20	0.70–2.09
Gender					
Male (Ref)	55 (60.4)	36 (39.6)	91	1.00	-
Female	52 (38.8)	82 (61.2)	134	2.44*	1.41–4.28
Profession					
Non-clinician (Ref)	80 (89.8)	34 (40.8)	84	1.00	-
Clinician	57 (40.1)	85 (59.9)	142	2.19*	1.27–3.80
Highest educational level					
Upper secondary (Ref)	7 (70.0)	3 (30.0)	10	1.00	-
Post-secondary non-tertiary	63 (46.1)	76 (53.9)	141	2.71*	1.06–10.96
Tertiary	37 (46.7)	46 (53.3)	73	2.67	0.64–11.10

Note: The totals are in row and therefore correspond to total percentages of 100%.

*Significant at 95%CI.

https://doi.org/10.1371/journal.pone.0257499.t003

Discussion

This study aimed to assess provider IF to the guidelines on TB screening among PLHIV attending HIV clinics in Ghana and potential factors associated with IF level. Despite the growing number of studies assessing fidelity of implementation in health, our study is the first in Ghana and one of the few in Africa to assess implementation outcome such as fidelity to the guidelins on TB screening at the HIV clinics. Most studies conducted in this area focused on intervention outcomes such as cured, died, completed treatment, among others [42, 54]. The determination of IF scores were done the summation approach based on providers' responses

Table 6. Multivariable logistic regression between implementation fidelity level and background factors with district hospital (random) effect.

Characteristics of providers	AOR	95% CI	p-value
Ecological zone			
Forest (*Bono, Ahafo, Ashanti & Eastern*) (Ref)	1.00	-	-
Savannah (*Upper East, Upper West & Northern*)	1.63	0.70–4.80	0.220
Coastal (*GT. Accra, Western, Central & Volta*)	0.93	0.38–2.21	0.842
Gender			
Male (Ref)	1.00	-	
Female	2.56	1.08–5.13	0.032*
Profession			
Non-clinician (Ref)	1.00	-	-
Clinician	1.78	1.07–3.59	0.045*
Highest educational level			
Upper secondary (Ref)	1.00	-	-
Post-secondary non-tertiary	2.05	0.48–14.65	0.260
Tertiary	4.81	2.13–9.19	0.047**

AOR = adjusted odds ratio,

* marginal significant and

** significant at 95%CI.

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to questions on core components of the intervention [55]. The IF level refers to those providers with composite scores equal or above the median score (high IF level) vs. those with composite scores below the median score (low IF level). This approach advances methods for measuring IF by statistically defining what constitutes high versus low level of fidelity. The creation of a level of implementation (low versus high implementation) is one of the two ways of assessing fidelity [15, 56], that is rarely applied in the IS literature.

Based on the structured questionnaires, the first key finding of this study is that, among all healthcare providers surveyed, 53% had scores equal or above the overall median fidelity score of 79%. Since there was no existing reference point of what constitutes high implementation fidelity level, using the median as a cut-off as done in our study implies that only 53% of the providers implemented the intervention with a higher level of fidelity than the 79%. The number who implemented with high fidelity was marginally (6% points) higher than those who implemented with lower fidelity score than the median. It is difficult to interpret whether a 79% fidelity score is adequate, for the TB screening intervention, in this context. This fairly high percentage of providers with lower adherence score (<79%) might lead to spurious conclusions about the effectiveness of the intervention [17, 57, 58]. Putting this finding in context, there is evidence that coverage of the intervention has been below set targets in the past years [51]. Our findings show that, overall, 47% of providers implement the intervention with low fidelity which may contribute to this sub-optimal coverage. We observed high provider fidelity scores in only 12 out of the 27 HIV clinics. Among the three components, providers in 16 clinics adhered to the items or activities constituting the TB diagnosis and the TB symptom questionnaire components. Provider non-adherence or low IF of healthcare interventions are known in the published literature to weaken chances of attaining intervention outcomes and render efficacious interventions ineffective in real life [22].

The next key finding of our study is that contextual factors (geographical location) influence the level of IF to the intervention. Even though a moderate proportion of healthcare providers implemented TB screening among PLHIV with high fidelity level overall, there were

marked statistically significant differences in the level of fidelity of implementation across some regions. Among the 10 regions of the country at the time of the study, most healthcare providers in five regions adhered (55–77%) to the intervention guidelines whilst in the other five regions, most did not (60–88%). The urbanity of the facility where the intervention is being implemented influences IF level [13, 55, 60]. Even though our study found some relationship between the regional locations of the district hospital and IF level, it is beyond the scope of this study to delve into urbanity of the district hospitals where this study was conducted. Although the samples sizes were small, regional location is a critical factor in our analysis because the health system of Ghana has cascading administrative management from regional through the district to hospital level and implementation of new intervention are discussed and planed using the top-bottom approach. Hospitals within the same region should share similar findings from an intervention. It will be worthwhile to investigate more fully the impact of context in the implementation of this intervention. Regions were re-grouped into three ecological zones (forest, savannah and coastal) due to insufficient sample size as mentioned. After accounting for the HIV clinic as a cluster effect, none of the ecological locations of the HIV clinic was found to statistically influence the IF level. That notwithstanding, since the TB screening intervention is guided by universal national protocols and guidelines it is expected that the adherence to intervention guidelines by providers will be uniform spatially. But our study found variability in IF spatially which is similar to the variability found between primary healthcare facilities in South Africa [30]. It is therefore important that supporting activities and resources aimed at ensuring provider adherence with TB screening should be streamlined across all regions to ensure uniformity in the delivery of the intervention.

Our study found that provider characteristics influenced IF level, similar to other studies in the literature [11, 12, 15, 56]. Factors reported in the literature to influence the level of fidelity include gender, education, cadre (profession), perceived need and benefit of the intervention, and work experience [15, 24]. Regarding factors that influence level of fidelity, we assessed the demographic aspect of the provider characteristics. Our findings from the cluster-based logistic regression analysis showed that the gender, profession, educational level of the providers were statistically significantly associated with provider IF to TB screening among PLHIV. This study found that after adjusting for the cluster effect (district hospital (HIV clinic)), female providers and clinicians adhered mostly to the implementation guideline and those with higher education also complied most to the intervention guidelines. We expected provider experience to influence IF but our study did not find such an association, though another study found that experience in terms of the number of years worked at the HIV clinic may not influence IF [60]. They argued that though providers experience is worth considering for implementation, in their study experience could not have predicted fidelity of implementation because most, if not all, healthcare providers had adequate levels of education and experience [60].

Strengths and limitation

To our knowledge, this study is one of the first that assess provider implementation fidelity to the TB screening intervention in sub-Sahara Africa particularly in the context of Ghana. This study thus assessed implementation outcome, whereas most studies assess the effectiveness of the intervention in terms of the intervention outcomes. This study was a census-based survey of all HIV care providers at all the study sites which allowed us to make a good conclusion. In an attempt to reduce and combine data, we attempted a robust analytical approach through a factor analytic technique to determine factors underlying assessment of IF of the intervention. This approach did not add any value to the analysis. We therefore resorted to using original

items to assess fidelity. Finally, modified CFIF directed the assessment of contextual and demographics factors found to relate to IF. The VIF showed that multicollinearity was not an issue of concerned in the logistic model.

The study also had some limitations. It assessed implementation fidelity using provider self-reported responses on how TB screening intervention among PLHIV is being implemented. Like all other studies of this nature, there is a major limitation with regards to the validity and accuracy of self-reported responses due to possible social desirability and recall bias [56, 61–63]. However, since providers interviewed were all active and currently delivering the intervention, issues with recall errors were highly minimized. Also, this method offers a time and cost-efficient means to obtain clinical and program level information from the provider perspective compared to methods that involve independent observations [22]. We had a challenge with the categorization of fidelity levels because there are no existing norms or references. We, therefore, chose the median as the cut-off because our data was not normally distributed. Median as a cut-off might lead to loss of information and reducing the statistical power to detect a relation between the variables and fidelity level, hence some of the findings should be interpreted with caution. Notwithstanding, the median serves as a yardstick and lesson learned can inform better implementation of the intervention in this and other settings. Also, categorizing fidelity into high or low simplified the statistical analysis which led to easy interpretation and presentation of our result.

Conclusion

IF studies are important yet there are no existing norms for its categorization. This study added to knowledge another way of determining IF levels and information needed to meaningfully conclude on the performance of the TB screening intervention implemented over a decade in Ghana.

The study suggests that a high level of IF to the intervention was marginally achieved, i.e. a little above the median fidelity score for each of the three components as well as the overall. We, therefore, found elements of healthcare provider adherence as well as some evidence of low IF among healthcare providers delivering TB screening intervention to PLHIV. Some researchers have referred to these bottlenecks in implementation fidelity as type III errors [58, 64] and argue that such errors can negatively affect intervention effectiveness. Nevertheless, regional location, gender, profession, and level of education were associated significantly with IF levels in this study. Supporting strategies such as continuous training, coaching and program review among providers and program managers should be at the core of program implementation in this context. Strategies for monitoring and measuring implementation fidelity should be clearly defined and implemented to offer constant program performance information to serve as the basis for recommendations to improve program implementation outcomes.

In summary, our study demonstrated a systematic way of assessing fidelity of implementation at the provider level using the core components of the intervention. IF assessment should be encouraged or incorporated into government or national interventions to understand the weakness and areas of the intervention that needs improvement to be able to keep to desire outcomes of interventions. Most fidelity assessments were done as such but implementation scientists should consider assessing fidelity at the health facility level. This is where resources and guidelines are discussed and discharged to providers. Finally, since the providers did not fully adhered to three components of the intervention, it however indicated an opportunity for improvement of the current implementation of the TB screening intervention among PLHIV attending HIV clinics.

Supporting information

S1 File. Supporting dataset.
(ZIP)

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References

1. Date A, Modi S. TB Screening Among People Living With HIV/AIDS in Resource-Limited Settings. JAIDS J Acquir Immune Defic Syndr. 2015 Apr 15; 68:S270–3. https://doi.org/10.1097/QAI.0000000000000485 PMID: 25768866
2. Getahun H, Van Gorkom J, Harries A, Harrington M, Nunn P, Perriens J, et al. INTERIM POLICY ON COLLABORATIVE TB/HIV ACTIVITIES. TB/HIV Research FoundationRegional Office for Africa South Africa). Paul Nunn Paul Pronyk; 2004.
3. WHO. WHO policy on collaborative TB/HIV activities Guidelines for national programmes and other stakeholders. 2012.
4. Gupta S, Granich R, Date A, Lepere P, Hersh B, Gouws E, et al. Review of policy and status of implementation of collaborative HIV-TB activities in 23 high-burden countries. Int J Tuberc Lung Dis. 2014 Oct 1; 18(10):1149–58. https://doi.org/10.5588/ijtld.13.0889 PMID: 25216827
5. Getahun H, Gunneberg C, Granich R, Nunn P. HIV Infection–Associated Tuberculosis: The Epidemiology and the Response. Clin Infect Dis. 2010 May 15; 50(s3):S201–7. https://doi.org/10.1086/651492 PMID: 20397949
6. Ghana Health Service. Implementation of TB / HIV collaborative activities in Ghana: Technical policy and guidelines. 2007.
7. Ghana Health Service. Implementation of TB/HIV collaborative activities in Ghana: Joint programme planning policy and guidelines. 2014.
8. Abebe R, Fentahun M, Hailemichael Y, Yitayew M, Zegeye MM. Hiv testing and counseling among patients with tuberculosis at arbaminch hospital, Southern Ethiopia. Am J Trop Med Hyg. 2013; 89 (5):232.
9. World Health Organization. Tuberculosis country profiles (Ghana). 2020.

10. World Health Organization W. GLOBAL TUBERCULOSIS REPORT 2020. 2020.

11. Hasson H. Systematic evaluation of implementation fidelity of complex interventions in health and social care. Implement Sci. 2010 Sep 8; 5(1):67. https://doi.org/10.1186/1748-5908-5-67 PMID: 20815872

12. Hasson H, Blomberg S, Dunér A. Fidelity and moderating factors in complex interventions: a case study of a continuum of care program for frail elderly people in health and social care. Implement Sci. 2012 Mar 22; 7(1):23. https://doi.org/10.1186/1748-5908-7-23 PMID: 22436121

13. Nurjono M, Shrestha P, Ang IYH, Shiraz F, Yoong JSY, Toh SAES, et al. Implementation fidelity of a strategy to integrate service delivery: learnings from a transitional care program for individuals with complex needs in Singapore. BMC Health Serv Res. 2019 Mar 19; 19(1):177. https://doi.org/10.1186/s12913-019-3980-x PMID: 30890134

14. Nilsen P, Bernhardsson S. Context matters in implementation science: A scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. Vol. 19, BMC Health Services Research. BioMed Central Ltd.; 2019. p. 189. https://doi.org/10.1186/s12913-019-4015-3 PMID: 30909897

15. Durlak JA, DuPre EP. Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. Am J Community Psychol. 2008 Jun; 41(3–4):327–50. https://doi.org/10.1007/s10464-008-9165-0 PMID: 18322790

16. Eboreime EA, Eyles J, Nxumalo N, Eboreime OL, Ramaswamy R. Implementation process and quality of a primary health care system improvement initiative in a decentralized context: A retrospective appraisal using the quality implementation framework. Int J Health Plann Manage. 2019 Jan 1; 34(1): e369–86. https://doi.org/10.1002/hpm.2655 PMID: 30216533

17. Department of Health and Human Services. USA. THE IMPORTANCE OF QUALITY IMPLEMENTATION FOR RESEARCH. 2013;(February).

18. Durlak JA. The importance of implementation for research, practice, and policy. Child Trends. 2011; 34:1–10.

19. Dusenbury L, Brannigan R, Hansen WB, Walsh J, Falco M, Ghana NACP, et al. Quality of implementation: developing measures crucial to understanding the diffusion of preventive interventions. Who. 2014 Jun 1; 15(1):1–9.

20. Roberts G (Gregory J.), Vaughn S, Beretvas SN, Wong V. Treatment fidelity in studies of educational intervention. Routledge; 2017.

21. Mihalic S. THE IMPORTANCE OF IMPLEMENTATION FIDELITY. 2002.

22. Breitenstein SM, Gross D, Garvey CA, Hill C, Fogg L, Resnick B. Implementation fidelity in community-based interventions. Res Nurs Health. 2010 Apr; 33(2):164–73. https://doi.org/10.1002/nur.20373 PMID: 20198637

23. Mowbray CT, Holter MC, Teague GB, Bybee D. Fidelity criteria: Development, measurement, and validation. Am J Eval. 2003 Sep 30; 24(3):315–40.

24. Carroll C, Patterson M, Wood S, Booth A, Rick J, Balain S. A conceptual framework for implementation fidelity. Implement Sci. 2007 Dec; 2(1):1–9. https://doi.org/10.1186/1748-5908-2-40 PMID: 18053122

25. Flottorp SA, Oxman AD, Krause J, Musila NR, Wensing M, Godycki-Cwirko M, et al. A checklist for identifying determinants of practice: A systematic review and synthesis of frameworks and taxonomies of factors that prevent or enable improvements in healthcare professional practice. Vol. 8, Implementation Science. 2013. https://doi.org/10.1186/1748-5908-8-35 PMID: 23522377

26. VanDevanter N, Kumar P, Nguyen N, Nguyen L, Nguyen T, Stillman F, et al. Application of the Consolidated Framework for Implementation Research to assess factors that may influence implementation of tobacco use treatment guidelines in the Viet Nam public health care delivery system. Implement Sci. 2017 Dec 28; 12(1):27. https://doi.org/10.1186/s13012-017-0558-z PMID: 28241770

27. Mihalic Sharon F.; Muller J. Blueprints, a Violence Prevention Initiative—Google Books.

28. Hulleman Chris S; Rimm-Kaufman Sara E; Abry T. Innovative methodologies to explore implementation: Whole-part-whole—Construct validity, measurement, and analytical issues for intervention fidelity. In Halle T., Metz A., & Martinez-Beck I. (Eds.), Applying implementation science in early childhood prog. APA. 2013;

29. Brown TA. Confirmatory Factor Analysis for Applied Research.

30. Lebina L, Alaba O, Ringane A, Hlongwane K, Pule P, Oni T, et al. Process evaluation of implementation fidelity of the integrated chronic disease management model in two districts, South Africa. BMC Health Serv Res. 2019 Dec 16; 19(1):1–14. https://doi.org/10.1186/s12913-019-4827-x PMID: 31842859

31. Cochrane LJ, Olson CA, Murray S, Dupuis M, Tooman T, Hayes S. Gaps between knowing and doing: Understanding and assessing the barriers to optimal health care. J Contin Educ Health Prof. 2007 Mar; 27(2):94–102. https://doi.org/10.1002/chp.106 PMID: 17576625

30. Lönnroth K, Corbett E, Golub J, Godfrey-Faussett P, Uplekar M, Weil D, et al. Systematic screening for active tuberculosis: Rationale, definitions and key considerations. Vol. 17, International Journal of Tuberculosis and Lung Disease. 2013. p. 289–98. https://doi.org/10.5588/ijtld.12.0797 PMID: 23407219

33. Peters DH, Tran NT, Adam T. Implementation Research in Health: A Practical Guide. Who. 2013; 88.

34. Roberts Greg; Vaughn Sharon; Beretvas S Natasha; Wong V. (PDF) Measuring Fidelity in Educational Settings. Routledge; 2017. 1–150 p.

35. Naleppa MJ, Cagle JG. Treatment Fidelity in Social Work Intervention Research: A Review of Published Studies.

36. Durak U, Schmitt A, Pawletta T. Model-Based Testing for Objective Fidelity Evaluation of Engineering and Research Flight Simulators. In American Institute of Aeronautics and Astronautics (AIAA); 2015.

37. Albert A, Hallowell MR, Kleiner B, Chen A, Golparvar-Fard M. Enhancing construction hazard recognition with high-fidelity augmented virtuality. J Constr Eng Manag. 2014 Jul 1; 140(7).

38. Kok MSY, Jones M, Solomon-Moore E, Smith JR. Implementation fidelity of a voluntary sector-led diabetes education programme. Health Educ. 2016; 116(1):62–81.

39. Schmidt B, Watt K, McDermott R, Mills J. Assessing the link between implementation fidelity and health outcomes for a trial of intensive case management by community health workers: A mixed methods study protocol. BMC Health Serv Res. 2017 Jul; 17(1):480. https://doi.org/10.1186/s12913-017-2420-2 PMID: 28716136

40. Ahortu CK, Bonsu F. Factors affecting TB case detection and treatment in the Sissala East District, Ghana. J Tuberc Res. 2013; 01(03):28–36.

41. Addo KK, Amponsah WK, Owusu R, Bonsu C, Narley N, Mensah GI, et al. First Nationwide Survey of the Prevalence of TB-HIV Co-Infection in Ghana. J Tuberc Res. 2018 May 9; 06(02):135–47.

42. Amoa GA, Ellis JS. Tuberculosis and HIV integration in sub-Saharan Africa. Asian Pacific J Trop Dis. 2015; 5(11):841–6.

43. Amoa GA, Walley JD, Siddiqi K, Wai X. Assessing the impact of TB/HIV services integration on TB treatment outcomes and their relevance in TB/HIV monitoring in Ghana. Infect Dis Poverty. 2012; 1(1):1.

44. Sidani S. Fidelity of Intervention Implementation: A Review of Instruments. Health (Irvine Calif). 1992; 7:1687–95.

45. Bellg AJ, Borrelli B, Resnick B, Hecht J, Minicucci DS, Ory M, et al. Enhancing treatment fidelity in health behavior change studies: best practices and recommendations from the NIH Behavior Change Consortium. Health Psychol. 2004 May; 23(5):443–51. https://doi.org/10.1037/0278-6133.23.5.443 PMID: 15367063

46. Bellg AJ, Borrelli B, Resnick B, Hecht J, Minicucci DS, Ory M, et al. Enhancing treatment fidelity in health behavior change studies: best practices and recommendations from the NIH Behavior Change Consortium. Health Psychol. 2004 May; 23(5):443–51. https://doi.org/10.1037/0278-6133.23.5.443 PMID: 15367063

47. Hernandez M, Gomez A, Lipien L, Greenbaum PE, Armstrong KH, Gonzales P. Use of the System-of-Care Practice Review in the National Evaluation. J Emot Behav Disord. 2001 Jan 14; 9(1):49–62.

48. Elbeik M. An approach to client satisfaction measurement as an attribute of health service quality. Health Care Manage Rev. 12(3):47–52. https://doi.org/10.1097/00004010-198701000-00009 PMID: 3823808

49. Stalker GR. Preventing pitfalls in patient surveys. Health Care Strateg Manage. 1988 May 1; 7(5):13–8. PMID: 10293191

50. Blodgett JG, Hill DJ, Tax SS. The effects of distributive, procedural, and interactional justice on postcomplaint behavior. J Retail. 1997 Jun 1; 73(2):185–210.

51. Ghana Health Service. IMPLEMENTATION OF TB/HIV COLLABORATIVE ACTIVITIES IN GHANA: JOINT PROGRAMME PLANNING POLICY AND GUIDELINES IMPLEMENTATION OF TB/HIV COLLABORATIVE ACTIVITIES IN GHANA JOINT PROGRAMME PLANNING POLICY AND GUIDELINES. Accra; 2014.

52. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ. 2011 Jun 27; 2:53–5. https://doi.org/10.5116/ijme.4dfb.8dfd PMID: 28029643

53. StataCorp. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC. 2017.

54. Osei E, Der J, Otasu R, Kotia P, Asuma WK. The burden of HIV on Tuberculosis patients in the Volta region of Ghana from 2012 to 2015: Implication for Tuberculosis control. BMC Infect Dis. 2017; 17(1):1–8.

55. Abry T, Hulleman CS, Rimm-Kaufman SE. Using Indices of Fidelity to Intervention Core Components to Identify Program Active Ingredients. Am J Eval. 2015 Sep 6; 36(3):320–38.

56. James Bell A. Evaluation Brief: Measuring Implementation Fidelity. James Bell Assoc. 2009;(October):1–6.

67. Lewis CC, Fischer S, Weiner BJ, Stanick C, Kim M, Martinez RG. Outcomes for implementation science: an enhanced systematic review of instruments using evidence-based rating criteria. Implement Sci. 2015 Dec 4; 10(1): 155. https://doi.org/10.1186/s13012-015-0342-x PMID: 26537706

68. Sánchez V, Steckler A, Nitkin P, Halfors D, Cho H, Brodish P. Fidelity of implementation in a treatment effectiveness trial of Reconnecting Youth.

69. Crosse S, Williams B, Hagen CA, Harmon M, Pistor L, DiGaetano R, et al. Prevalence and Implementation Fidelity of Research-Based Prevention Programs in Public Schools: Final Report.

70. Klimes-Dougan Bonnie, August Gerald J., Lee Chih-Yuan Steven, Realmuto George M., Bloomquist Michael L., Horowitz Jason L., et al. Practitioner and site characteristics that relate to fidelity of implementation: The Early Risers prevention program in a going-to-scale intervention trial. Professional Psychol Res Pract. 2009; 40(No. 5):467–75.

71. Breitenstein SM, Gross D, Garvey CA, Hill C, Fogg L, Resnick B. Implementation fidelity in community-based interventions. Res Nurs Heal. 2010 Apr; 33(2):164–73. https://doi.org/10.1002/nur.20373 PMID: 20198637

72. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. 2009; 1:1–15.

73. Ennett ST, Haws S, Ringwalt CL, Vincus AA, Hanley S, Bowling JM, et al. Evidence-based practice in school substance use prevention: fidelity of implementation under real-world conditions. Health Educ Res. 2011 Apr; 26(2):361–71. https://doi.org/10.1093/her/cyr013 PMID: 21385892

74. Dobson KS, Singer AR. Definitional and Practical Issues in the Assessment of Treatment Integrity. Clin Psychol Sci Pract. 2005 May 11; 12(4):384–7.

Appendix B: Original paper 2

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BMC Health Services Research

RESEARCH Open Access

Adherence of HIV clinics to guidelines for the delivery of TB screening among people living with HIV/AIDS in Ghana

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Abstract

Background: Tuberculosis screening of people living with HIV (PLHIV) – an intervention to reduce the burden of TB among PLHIV – is being implemented at HIV clinics in Ghana since 2007, but TB screening coverage remains low. Facility adherence to intervention guidelines may be a factor but is missing in implementation science literature. This study assesses the level of HIV clinic adherence to the guidelines and related facility characteristics in selected district hospitals in Ghana.

Methods: This cross-sectional study was conducted in all 27 district hospitals with HIV clinics, X-ray and GeneXpert machines in Ghana. These hospitals are in 27 districts representing about 27% of the 100 district hospitals with HIV clinics in Ghana. A data collection tool with 18-items (maximum score of 28) was developed from the TB/HIV collaborative guidelines to assess facility adherence to four interrelated components of the TB screening programme as stated in the guidelines: Intensive TB case-finding among PLHIV (ITCF), Isoniazid preventive therapy initiation (IPT), TB infection control (TIC), and programme review meetings (PRM). Data were collected through record review and interviews with 27 key informants from each hospital. Adherence scores per component were summed to determine an overall adherence score per facility and summarized using medians and converted to proportions. Facility characteristics were assessed and compared across facilities with high (above median) versus low (below median) overall adherence scores, using nonparametric test statistics.

Results: From the 27 key interviews and facility records reviewed, the median adherence scores for ITCF, IPT, TIC, and PRM components were 85.7% (IQR: 85.5–100.0), 0% (IQR: 0–66.7), 33.3% (IQR: 33.3–50.0), and 90.0% (IQR: 70.0–90.0), respectively. The overall median adherence score was 62.1% (IQR: 58.6–65.1), and 17 clinics (63%) with overall adherence score above the median were categorized as high adherence. Compared to low adherence facilities, high adherence facilities had statistically significant lower PLHIV clinic attendees per month (256 (IQR: 60–904) vs. 900 (IQR: 609–2622); $p = 0.042$), and lower HIV provider workloads (28.6 (IQR: 8.6–113) vs. 90 (IQR: 66.7–263.5); $p = 0.046$), and most had screening guidelines (76%, $p < 0.01$) and questionnaire (80%, $p < 0.01$) available on-site.

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Conclusion: PRM had highest score while the IPT component had the lowest score. Almost a third of the facilities implemented the TB screening programme activities with a high level of adherence to the guidelines. We suggest to ensure adherence to all four components, reducing staff workloads and making TB screening questionnaires and guidelines available on-site would increase facility adherence to the intervention and ultimately achieve intervention targets.

Keywords: Programme adherence, Facility characteristics, TB screening, PLHIV, HIV clinics, Implementation research, Ghana

Background

Tuberculosis (TB) is a significant public health problem of global concern [1, 2]. Though curable, it is a significant contributor to deaths among people living with HIV (PLHIV) [3]. Due to their immune-compromised systems, PLHIV are 20–30 times more likely to contract active TB than non-HIV infected people [4, 5]. Among PLHIV with TB, the lifetime risk of dying is 50% compared to 5–10% in non-HIV infected people with TB [5–8].

To reduce the dual burden of TB and HIV in the population, the World Health Organization (WHO) instituted policy guidelines on TB/HIV collaborative activities in service delivery [4, 5]. These WHO policy guidelines [4] recommend the use of a simplified TB screening questionnaire that asks PLHIV about the absence or presence of four clinical TB symptoms (current cough, weight loss, fever and night sweats) in order to identify screen-negative people and initiate them on Isoniazid preventive therapy (IPT) as prophylactic treatment [4, 9, 10]. The screening is to be done at the initial diagnosis or presentation of HIV and every subsequent visit for HIV care [11]. Many countries where the burden of TB/HIV co-infection is high, including Ghana, are implementing TB screening of PLHIV amongst other TB/HIV collaborative interventions [12].

The estimated prevalence of TB in Ghana in 2017 was 152 per 100,000 population, and 27% of TB patients were co-infected with HIV [13]. Ghana started implementing the TB screening among PLHIV in 2007 as a control measure. In 2014 the policy and guidelines for the implementation of TB/HIV collaborative activities in Ghana were revised to provide a detailed way for enhancing the collaboration between the Ghana National Tuberculosis Control Programme (NTP) and the National AIDS/STI Control Programme (NACP) [5]. The revised document [5] outlined responsibilities for all levels of delivery in TB/HIV collaboration, including the health facility and healthcare providers level. With the aim of reducing TB burden among PLHIV, the revised policy set out targets for TB screening coverage (56%, 64%, 70%, 80%, 85% and 90% in 2015 to 2020 respectively) among PLHIV in HIV care or treatment settings [5, 14]. The TB screening intervention as per the NTP is ongoing at all district hospitals (DHs) with a functioning HIV clinic, as set out in the detailed policy and guidelines [5].

Evidence from the literature [7, 9, 15, 16] shows that TB screening among PLHIV is a critical and necessary step to implementing Isoniazid preventive therapy (IPT) initiation, towards reducing the burden of TB in PLHIV. However, the expected outcome of the intervention has not been fully achieved in Ghana since its implementation. For instance, about 60 and 41% of PLHIV attending clinics in Ghana were not screened for TB in 2013 and 2014 respectively [5, 17] (this was part of the reason for the 2014 TB/HIV policy review) and 47.9% in 2019 [18]. What is not clear is why this intervention of proven effectiveness [19] is not producing the expected result in Ghana. Implementation effectiveness is determined by measuring implementation outcomes such as implementation fidelity [20], sometimes referred to as adherence, which is defined as implementing an intervention according to programme design or guideline [21].

Health programs often provide implementation guidelines for *(1)* the organization/facility (programme level guidelines to which health facilities or other implementing units should adhere), and *(2)* healthcare providers to apply (clinical guidelines) [4, 5, 22–24]. The extent of adherence to TB screening among PLHIV at the organizational or facility level is an essential discussion missing in the implementation science literature. Furthermore, research shows that factors such as *organizational structure, staffing availability, physical facilities and resources,* and *geographical location* influence adherence to health programs [25–28], no research is available on the extent to which health facilities in Ghana adhere to the programme guideline on TB screening of PLHIV.

This study aim was to investigate programme fidelity or the level of adherence by district hospital HIV clinics in Ghana to the guidelines on the delivery of TB screening amongst PLHIV. In the context of our study, programme adherence refers to the degree to which the DHs deliver the TB screening of PLHIV intervention according to the Ghana NTP guideline. However, the extent to which DHs in Ghana adhere to these programme guideline components has not been assessed. We

expected that the level of adherence by the health facilities to the guidelines would vary across facility characteristics. Therefore our secondary aim was to examine the significant differences in facility characteristics between facilities with high adherence and low adherence level. We anticipate the result can inform the designers of the NTP and the TB screening programme at the facility level on areas for improvement in the implementation process.

Methods

Study setting

Ghana is administratively divided into 216 districts across 10 regions [29]. These regions are further grouped into three ecological zones (Savannah, Forest and Coastal zones) based on their economic activities and ecology. The health system is divided along the existing administrative regions and districts [30], with decentralised health management teams at the district level. The DHs serve as the first point of referrals from the peripheral health facilities and provide both outpatient and in-patient services. Each DH provides services to a population of 100,000 to 200,000 people with between 50 to 60 available beds. Each district is expected to have a DH, but as of 2017, there were 144 DHs across the country [30], 100 of which had an HIV clinic or treatment setting, and delivered the TB screening intervention targeting PLHIV attending the HIV clinic [6].

A team of health professionals led by the head of the district hospital (medical doctor) facilitates the delivery of the TB/HIV collaborative activities at the district hospital level. The head of the facility is the point of call for undertaking any health-facility based intervention. Other key team members include the facility TB/HIV coordinator (disease control officer or nurse) appointed to be responsible for running the day-to-day implementation and oversight of the TB/HIV collaborative activities and head of the HIV clinic (medical assistant) who manages staff and activities at the clinic.

The NTP guideline outlines the activities required at all the HIV clinics for the delivery of TB screening of PLHIV [5, 14]. These activities include ensuring the availability of an HIV clinic, providing services for routine TB screening for PLHIV, providing TB confirmatory procedures through sputum testing or chest x-ray, ensuring TB infection and control activities, and conducting regular meetings on TB case finding with HIV care providers for feedback [4, 5]. The use of IPT in all PLHIV was not a national policy in Ghana; however, it is supported in HIV specialised cases and children under 5 years where patients are supervised to go through and complete treatment [5]. In 2017, the Ghana NTP earmarked 27 of the 100 DHs with HIV care or treatment services to implement the initiation of IPT for all PLHIV who screened negative on TB screening [31]. According to the IPT implementation plan by the Ghana Health Service, the 27 facilities were selected because they were ART sites with both digital x-ray machines and GeneXpert at the time of implementation. The justification was that it is easier to monitor them as initial roll-out sites because they had molecular diagnostic equipment such the digital x-ray and GeneXpert machines needed to rule out active TB before initiating the IPT. This study was therefore conducted in these 27 DHs representing 27% of the 100 DHs with HIV clinics in Ghana.

Study design

This was a cross-sectional and census-based study which is part of a more extensive study that assessed the implementation fidelity and determinants of TB screening and IPT initiation among HIV clients attending HIV clinics in Ghana. Every evidence-based intervention has critical components [32–34], and how well these components are implemented determines the effectiveness or success of the intervention [35]. According to Carroll et al.'s conceptualisation of fidelity [21], adherence is defined in terms of four constructs – content (implementing the required intervention content), frequency, duration and coverage.

To investigate the level of adherence by the DHs to the intervention guideline, we adapted the Conceptual Framework for Implementation Fidelity proposed by Carroll [21]. Three of Carroll's four constructs – content, frequency and coverage of the intervention [21] – were thought applicable and relevant to this study.

Components of the intervention

Intervention implementation in a health facility follows a "top-down" approach (facility level to the provider level) [36]; adherence at the facility level ("top") influences the degree to which an intervention is implemented [21] at the provider level ("bottom").

From the content of the NTP guidelines (which also align with WHO's recommendation), we identified four components of the intervention as follows

1. *Intensive TB case-finding among PLHIV (ICF)* through the HIV clinic by screening all PLHIV attending HIV clinic for TB, conducting TB evaluation and the extent to which there was regular or routine delivery of these activities as required by the guidelines;
2. *IPT initiation (IPT)* in specialised cases recommended by clinicians. These include children under 5 years who are exposed to people with active TB and persons with immunosuppression as a result of chemotherapy, prolonged steroid use and persons on renal replacement therapy [5];

3. *TB infection control (TIC)* to prevent the spread and increase of TB in the facility through activities such as having TB infection control plan, a mandatory examination of all health workers for TB and administrative, environmental and personal protection control; and
4. *Programmes review meeting (PRM)* to be conducted monthly to involve all the HIV clinic staff discussing issues with quality data sharing and feedback.

These components and their activities were designed to align with NTP guidelines. The four major components identified from the guidelines comprised some activities that when implemented, the aim of the intervention will be realised.

Study sample

All the 27 DHs that had been earmarked by the NTP to be the first facilities providing IPT initiation for PLHIV were included in this study. The NTP listed these 27 facilities to implement the integrated TB/HIV intervention (IPT initiation) based on the fact that they have functioning HIV clinics and have both digital X-ray and GeneXpert testing capacity to rule out TB disease [37].

For this study, the intent was to interview the 27 DHs heads, but where the head was unavailable, we interviewed the facility TB/HIV coordinator or the head of the HIV clinic instead. The TB registers were reviewed and data extracted for the year 2018. The assessment of fidelity in this study was from the perspective of the hospital managers.

Data collection and measurement

Data collection was from 9th –24th April 2019 by a team of 12 field officers. Using the intervention components identified, we developed an adherence assessment tool because none existed. The tool which was partly questionnaire and partly data extraction form was designed to score the extent to which the DHs adhered to the guidelines – i.e. whether they undertook the prescribed activities of the four components (ITCF, IPT, TIC, and PRM). These activities were therefore used as variables on the tool. Data were collected in two stages on weekdays. The first stage was a face-to-face interview through the administration of a semi-structured questionnaire to the head of the DH or appointed representative. The questionnaire was structured to collect data on the socio-demographic (age sex, cadre, etc.) of the respondent, TB screening activities provided by the facility, and availability of resources (staff, TB screening questionnaire, TB/HIV clinical manual, etc.). The second stage involved using a predesigned data extraction form to extract from the TB and HIV clinic care registers monthly aggregated TB patient data for the period of 1 January to 31December 2018. Data on number of new and existing HIV patients, number screened for TB, number presumed TB, number confirmed and number initiated on IPT were extracted. (See Additional file 1.docx which is a table (Table S1) providing detail information on the elements in the data extraction form and the questionnaire). Where any of these data were missing, the health information officer in charge at the HIV clinic was consulted for rectification. Unresolved missing records were classified incomplete and therefore excluded; 2 records were excluded. All the data collection tools were pre-tested in two similar facilities to minimize measurement errors and identify problem areas for rectification. Three interviews were conducted in each facility (Heads of facility, HIV clinic and facility TB/HIV coordinator) and monthly data for 12 months was extracted for each facility.

To measure programme adherence, the four critical components of the intervention (as described above) were identified and the study collected data to measure the facility adherence to each of these components (activities). Adherence was scored per activity. The fact that the guidelines detailed how these activities should be implemented, we scored the activity as adherent/not adherent if the recommended activity was implemented/not implemented accordingly [38]. Table 1 presents the four components of the intervention for TB screening among PLHIV, the items (activities) and score per component, and the source of information.

As shown in Table 1, each of the four major components of the intervention comprise a different number of activities (ITCF 5; IPT 3; TIC 5; and PRM 6). Most of the activities were scored 0 (activity not implemented by the DH) or 1 (activity implemented by the DH). Other activities had a score ranging from 1 to 3. For instance, the scores for "frequency of TB screening" ranged from 1 (HIV clinic provides screening for TB on 1 day a week) to 3 (HIV clinic provides screening for TB on every day of the week) while the scores for "review meeting involve all HIV care providers" ranged from 0 (review meeting never include all HIV healthcare providers) to 2 (review meeting always includes all HIV healthcare providers). Respondents were also asked an open-ended question "how facility ensures TB infection control". The responses were post-coded into three activities (administrative, environmental and personal protective measures and surveillance of TB among workers) with scores of 0 (activity not implemented) or 1 (activity implemented). The total maximum possible adherence score from all the 19 activities was 29 (ITCF 7; IPT & TIC 6; and PRM 10) per DH (Table 1).

To examine differences in the facility characteristics between adherence levels, we collected data on the

Table 1 TB screening activities and scores by component and source of information

Components of TB screening intervention	Intervention activity	Subcategory of adherence applicable	Activity score (maximum)	Source of information
Intensive TB case-finding among PLHIV (ITCF) (HIV clinic performs these activities)	1. TB screening for PLHIV	Content	1	Interview
	2. Sputum evaluation of presumed TB cases	Content	1	Interview
	3. X-ray evaluation of presumed TB cases	Content	1	Interview
	4. Frequency of TB screening provision at the clinic	Frequency	3	Interview
	5. Screening coverage: proportion of PLHIV screened for TB	Coverage	1	TB and HIV register
IPT initiation (IPT) (HIV clinic initiates IPT to these clients)	6. Specialized cases	Content	2	Interview
	7. Children under 5 years	Content	2	Interview
	8. All PLHIV	Content	2	Interview
TB infection control (TIC) (DHs provides these activities)	9. General TIC at the facility	Content	2	Interview
	10. Administrative measure	Content	1	Interview
	11. Environmental measure	Content	1	Interview
	12. Personal protective measure	Content	1	Interview
	13. Surveillance of TB among workers	Content	1	Interview
Programme review meeting (PRM) (HIV clinic performs or provide these activities)	14. TB and HIV review meeting	Content	1	Interview
	15. Uniform and quality data	Content	1	Interview
	16. Share and analyses data at all levels	Content	1	Interview
	17. Provide feedback to all levels	Content	1	Interview
	18. HIV clinic holds regular review meeting	Frequency	4	Interview
	19. Review meetings involve all HIV care providers	Coverage	2	Interview
Total	19		29	

geographical location of the DH which is related to the physical location where the DH is situated in the country described by ecological zone (region and zone); *healthcare staffing level and workload* being the aspect of HIV healthcare providers and work distributions in the facility needed to facilitate the success of the implementation (these factors included the *numbers of HIV healthcare providers, PLHIV attending the HIV clinic per month, screened for TB per month, and calculated workload*); and *physical facilities and resources* consisted of the aspect of inputs available to facilitate the success of the implementation, such as availability of TB screening questionnaire, TB screening guideline, TB IE&C materials and guidelines for infection control in the DH.

Data management and analysis

The data collected with the paper-based questionnaire were captured onto EpiData version 3.1 software while the service records data were captured in MS Excel. All the 27 facilities involved in the study were assigned 4-letter codes which were used on both datasets, with no identifiers. Both datasets were password-protected and imported into STATA 16 software [39] for cleaning and analysis.

We conducted baseline descriptive analysis of the characteristics of the respondents and the DHs. Descriptive statistics including percentages, ratios, median and interquartile ranges (IQR) were used to summarise the characteristics such as age, sex, profession, DH location, length of time working at the facility, education, and HIV healthcare providers workloads.

We determined adherence score for each of the four intervention components per DH by summing the activity (item) scores for each intervention component. Reliability check was conducted using Cronbach's alpha for each of the four components of the TB screening programme at the facility level. An equally weighted additive method was further used by summing the four component adherence scores to generate an overall programme or facility adherence score per DH. These adherence scores were further expressed as percentages of the respective maximum possible scores for descriptive analysis. Because there is no known predefined cut-off point to define high or low programme adherence level, a median percentage score was calculated and used

as a cut-off to categorize scores into high or low adherence. A percentage score below the calculated median percentage score of 62.1% was categorized as low adherence. This categorization was used to determine the programme adherence level for each facility, whether it fall within the low or high adherence category. The health facilities were described as high or low using proportion. A Mann-Whitney U test, Spearman's correlation coefficient and Kruskal-Wallis tests at a 5% significance level were used to assess for statistically significant differences in facility characteristics between facilities with overall high adherence score and those with low score.

Ethical considerations

This study was approved by the University of the Witwatersrand, South Africa (ref: M190110) and the Ethical Review Committee of the Ghana Health Service (ref: GHS-ERC012/01/19). All procedures involving human participants performed in this study were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Results

Characteristics of the study participants

The study participants therefore consisted of 27 respondents, of which 18 (66.7%) were heads of facilities, 8 (29.7%) were facility TB/HIV coordinators, and 1 (3.7%) was the head of HIV clinic. We found from the study that the mean age of the respondents was 41.2 (standard deviation (SD) = 8.7) and about half of the respondents (*n* = 14, 51.9%) had worked in the facility for less than 5 years. Most of the respondents were males (*n* = 22, 81.5%), had worked in their current position for less than 5 years and (*n* = 15, 55.6%), were physicians (*n* = 22, 81.2%), and had attained postgraduate as the highest level of education (*n* = 21, 77.8%) as shown in Table 2.

Characteristics of the health facilities

Out of the 27 DHs studied, eleven were geographically located in the Forest zone, nine from Coastal and seven from the Savannah zones. All these DHs had HIV clinics that had adopted the integration of the TB screening intervention among the PLHIV attending the clinic. All the clinics operated five working days per week (excluding public holidays) and 8 h a day from 8 O'clock in the morning with all providers certified by professional bodies accredited by Ghana Health Service. Table 3 provides a descriptive overview of the facilities included in the analysis. The number of HIV healthcare providers per facility ranged from 8 to 10. The monthly HIV clients attendance per facility vary with a median attendance of 609 (IQR: 182–1479) while the monthly median number of PLHIV screened for TB was 79 (IQR:32–344). The median workload (HIV healthcare providers to HIV clinic attendance was 67 (IQR: 18–127). Most (74.1 and 77.8%) of the facilities have TB screening questionnaires and guidelines respectively available. However, other

Table 2 Characteristics of the study participants

Characteristics of respondents	Response Category	Number (%)
Role in the DH	Head of HIV clinic	1 (3.7)
	TB/HIV coordinator	8 (29.6)
	Head of the facility	18 (66.7)
Age in completed years (Mean & SD)		41.2 (8.7)
Gender	Female	5 (18.5)
	Male	22 (81.5)
Number of years working at the facility	<5 years	14 (51.9)
	5 years plus	13 (48.1)
Number years working in current role	<5 years	15 (55.6)
	5 years plus	12 (44.4)
Main occupation of respondent	Non-clinician	5 (18.5)
	Clinician	22 (81.5)
Highest educational level	Post-secondary non-tertiary	6 (22.2)
	Tertiary	21 (77.8)
Facility location (zone)	Savannah	7 (26.0)
	Forest	11 (40.7)
	Coastal	9 (33.3)

Abbrv: *DH* District Hospital, *SD* Standard Deviation

Table 3 Characteristics of the health facilities by ecological zones

Variables		Ecological zone Median (IQR), N (%)			p-value
	All (N = 27)	Savannah (n = 7)	Forest (n = 11)	Coastal (n = 9)	
Median number of HIV healthcare providers per HIV clinic	9 (5–10)	8 (7–8)	9 (7–11)	10.0 (10–10)	0.018
Median number of PLHIV attending the HIV clinic per month	609 (182–1479)	600 (60–1029)	924 (257–4842)	495 (60–900)	0.177
Median number of PLHIV screened for TB per month	79 (32–344)	69 (57–410)	200 (58–904)	32 (26–79)	0.315
Median number of patients per provider per monthly	67 (18–127)	66 (8–128)	113 (28–620)	43 (7–93)	0.157
TB screening questionnaire available					0.295
No	7 (25.9)	1 (14.3)	2 (18.2)	4 (44.4)	
Yes	20 (74.1)	6 (85.7)	9 (81.8)	5 (55.6)	
TB/HIV clinical manual available					0.107
No	23 (85.2)	5 (71.4)	11 (100.0)	7 (77.8)	
Yes	4 (14.8)	2 (28.6)	0 (0.0)	2 (22.2)	
TB screening Guideline available					0.606
No	6 (22.2)	1 (14.3)	2 (18.2)	3 (42.7)	
Yes	21 (77.8)	6 (85.7)	9 (81.8)	6 (66.7)	
TB IEC materials available					0.276
No	24 (88.9)	6 (85.7)	11 (45.8)	7 (77.8)	
Yes	3 (11.1)	1 (14.3)	0 (0.0)	2 (22.2)	
TB prevention and infection control guideline available					0.107
No	23 (85.2)	5 (71.4)	11 (45.8)	7 (77.8)	
Yes	4 (14.8)	2 (28.6)	0 (0.0)	2 (22.2)	

Note: IEC information, education and communication

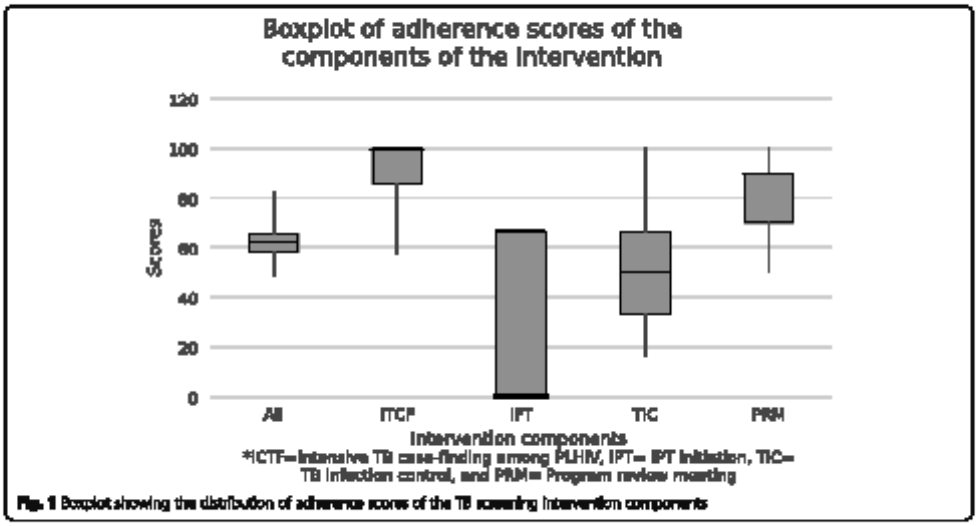

Fig. 1 Boxplot showing the distribution of adherence scores of the TB screening intervention components

resources such TB/HIV clinical manual, TB information, education and communication (IEC) materials and TB prevention and infection control guidelines as were not available on most facilities. See Additional file 2.docx which is a table (Table S2) providing descriptive information on the characteristics of the facilities by the HIV clinics.

TB screening implementation fidelity

Adherence scores

The overall adherence score and scores for each of the four components of the TB screening of PLHIV intervention are presented by the boxplot in Fig. 1.

The overall adherence score (summation of items of all components) for the facilities ranged from 48.3 to 83.8%, with a median of 62.1% (IQR: 58.6–65.1). The median scores for each of the four components differ. Median scores and IQR for the four components were: ITCF (85.7%; IQR: 85.7, 100%); IPT (0; IQR: 0, 66.7%); TIC (50%; IQR: 33.3, 66.7%); and PRM (90%; 70, 90%). Among the four components, PRM had highest score while the IPT component had the lowest score. Also, with the ITCF component, the 1st quartile and the median scores were the same (85.7%) while the 3rd quartile and the maximum scores were also the same (100%). With the IPT component, the minimum score, the 1st quartile and the median were the same (0%) while the 3rd quartile and the maximum score were the same (66.7%). Similarly, with the PRM component, the median score and the 3rd quartile score was the same (90%). None of the components and the overall had an outlier score.

The internal consistency for each of the four intervention components (ITCF, IPT, TIC, and PRM) and the overall programme were 0.59, 0.94, 0.63, 0.57, and 0.69, respectively. As the calculated alpha approaches one, it indicates that the items measure the components as intended to well and are interrelated within the test [40, 41].

Facility/programme adherence level

The programme adherence median score of 62.1% was used as the cut-off point to categorise the facilities into to a low or high adherence level. We found that 17 (63.0%) facilities scored ≥62.1% to fall in the high adherence category, while 10 (37.0%) facilities scored <62.1% to fall in the low adherence level category as showed by Fig. 2.

Differences in facility characteristics between high and low adherence level facilities

The characteristics of the facilities studied were grouped as geographical location, Health facility utilisation and staffing workload, and physical facilities and resources. In the Table 4, the assessment for significant differences in facility-level factors between the low and high adherence level facilities is presented.

The study shows that most DHs in the Savannah (71.4%), Coastal (66.7%) and Forest (54.6%) zones adhered to the implementation guidelines and activities (high adherence level); however, the result showed that

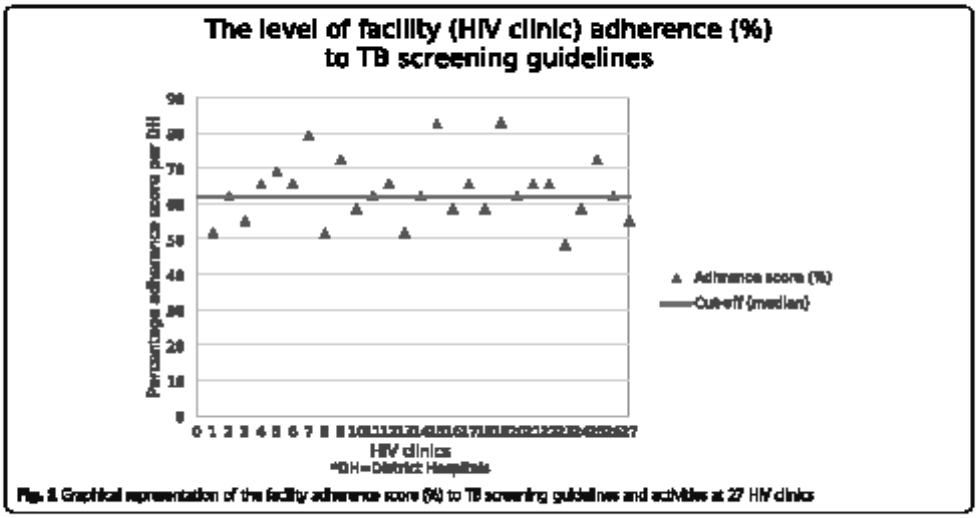

Fig. 2 Graphical representation of the facility adherence score (%) to TB screening guidelines and activities at 27 HIV clinics

Table 4 Association between facility-level factors and programme adherence level

Facility factors	Low adherence level N (%), Median (IQR)	High adherence level N (%), Median (IQR)	Significance
Geographical location			
Ecological zone			[a]p = 0.876
Savannah	2 (28.6)	5 (71.4)	
Forest	5 (45.5)	6 (54.5)	
Coastal	3 (33.3)	6 (66.7)	
Physical facilities and resources			
TB screening questionnaire available			[a]p = 0.008
No	6 (85.7)	1 (14.3)	
Yes	4 (20.0)	16 (80.0)	
TB/HIV clinical manual available			[a]p = 0.570
No	9 (50.1)	14 (50.9)	
Yes	1 (25.0)	3 (75.0)	
TB screening guideline available			[a]p = 0.009
No	5 (83.3)	1 (16.7)	
Yes	5 (25.0)	16 (76.2)	
TB IEC materials available			[a]p = 0.508
No	9 (52.5)	15 (62.5)	
Yes	1 (33.3)	2 (66.7)	
TB prevention and infection control guideline available			[a]p = 0.570
No	9 (50.1)	14 (50.9)	
Yes	1 (25.0)	3 (75.0)	
Health facility utilization and staffing workload			
Median number of HIV healthcare providers per HIV clinic.	9.5 (9–10)	9 (8–10)	[b]p = 0.726
Median number of PLHIV attending the HIV clinic per month.	900 (609–2622)	256 (60–904)	[b]p = 0.042
Median number of PLHIV screened for TB per month.	74 (26–277)	200 (38–419)	[b]p = 0.345
Median number of patients per provider per month	90 (66.7–263.5)	28.6 (9.6–113)	[b]p = 0.046

Note: [a] used Kruskal-Wallis test, [b] used Mann-Whitney U, and [c] used Spearman's correlation coefficient to assess significance difference. IEC Information, education and communication

the mean adherence score was not statistically insignificant ($p = 0.876$) between the three groups.

The findings showed that amongst the health facility utilization and staffing workload factors, the mean overall adherence score was statistically significant different in monthly patient load and provider workload between low and high adherence levels. Compared to the high adherence facilities, the low adherence facilities had a significantly higher median number of PLHIV attending HIV clinics per month (900; IQR: 609–2622 vs. 256; IQR: 60–904), and a significantly higher patient to provider ratio ($p = 0.046$). The mean overall adherence score was not statistically significant different ($p > 0.05$) for number of HIV healthcare providers or the number of PLHIV screened for TB at the facilities.

Among the physical facilities and resources factors, the study revealed that only the availability of TB screening questionnaire and TB screening guideline were significantly associated with adherence level. Most HIV clinics where TB screening questionnaires (80.0%) and TB screening guidelines (76.2%) were available, were in the high adherence group while most clinics without these documents for implementing the intervention were in the low adherence group ($p < 0.01$). We found that the mean overall adherence score was not statistically significant different in the availability of TB/HIV clinical manual ($p = 0.589$), TB IE&C materials ($p = 0.898$), and TB prevention and infection control guidelines ($p = 0.589$) between adherence levels.

Discussion

This study used a cross-sectional design to investigate the adherence level to programme guidelines for implementing the TB screening activities at the HIV clinics and related facility factors at selected HIV clinics in Ghana. Our study found seventeen (63.0%) of the 27

facilities had a high adherence level meaning they implemented most of the activities in the clinic according to the intervention guidelines. The intervention component with the highest adherence score was programme review meeting (PRM) followed by intensive TB case-finding among PLHIV (ITCF) and then TB infection control (TIC) components while the IPT component scored the least among the four components. Although over half the number of DHs studied implement the TB screening intervention with high level adherence to the guideline, the difference in the proportion is suboptimal. The low adherence scores for TIC and especially IPT by some HIV clinics could explain why about 37% of the facilities were in the low programme adherence level. Similarly, Fagan J A, 1990 found in their Violent Juvenile Offender Program that intervention sites that received moderate to high adherence scores or ratings in implementing most of the core components of the program fared much better compared to sites that received weak to moderate scores [42]. Contextual adaptation by modifying what may be adaptable and maintaining the critical components with their respective items may be needed to enhance adherence to TIC and IPT components [43, 44]. Nonetheless, actual reasons for the low adherence to TIC and IPT which would inform scale-up, scale-out and process evaluation needs further research.

The WHO recognizes that implementation guidelines promote standardization and simplification in implementing an effective intervention [45, 46] in real life. But, suboptimal facility adherence level to intervention guidelines is known to result in an unsuccessful intervention outcome [47, 48]. Thus, the finding of this study provides a possible explanation for the low and fluctuating TB screening coverage among PLHIV attending HIV clinics in Ghana, an observation that led to the revision of the TB/HIV collaborative guideline with newly set targets in 2014 [5]. With the facility adherence level found in our study, it will be quite challenging to achieve the 2018 target of 80% TB screening coverage among PLHIV at the HIV clinic in Ghana. No previous study on facility adherence or fidelity on TB screening guidelines available.

Adherence as a determinant of failure or success of the implementation of an intervention is influenced by important factors [49] of which some are related to the organization in which the intervention is being implemented. Given the relationship between facility or organizational factors and how an intervention is implemented in a health facility [25], we examined facility-level factors that were relevant and likely to have an impact on the implementation of the intervention in several studies, including geographical location, staffing and workload, and facility resources [49–63]. Some of these factors examined appeared to have little influence on the adherence level. For example, the relationship between geographical location (being in Savannah, Forest or Coastal zones of Ghana) and programme adherence level was not statistically significant. Notwithstanding, we found some variability between geographical location on level of adherence in the implementation of the TB screening intervention, with facilities in the Savannah zone having higher adherence compared to the Coastal and Forest zones in that order. In terms of HIV prevalence, the Ghana Demographic and Health Survey report (2014) showed that, most regions in the Savannah zones have the lowest prevalence rates, followed by Coastal zone while the Forest zone has the region with the highest rate [54]. This corroborates our findings that, the Forest zone has the highest median number of PLHIV attending the HIV clinics per month [55, 56]. The variability in adherence levels observed across geographical zones could be due to fewer number of PLHIV attending HIV clinics in Savannah than Forest zones per month. However, our findings may be a function of the small number of sample (27 facilities) involved in the study and insufficient power to conduct robust statistical analyses to test for association. Nonetheless, our findings are consistent with other studies [57, 58].

We also explored the relationship between adherence level and other facility characteristics covering healthcare staffing levels and workloads. We found that facilities with high programme adherence level had significantly lower numbers of PLHIV attending the HIV clinic per month and lower HIV healthcare provider-HIV client ratios than facilities with low programme adherence level. Although there is no significant difference in the number of HIV healthcare provider between the adherence levels, inversely, high adherence level facilities screened more PLHIV for TB than low adherence level facilities; however, the difference is not significant. Facilities seeing more clients screened less PLHIV for TB. Systematic reviews [59, 60] confirmed earlier assertions that provider staffing is associated with intervention outcomes. The provider-patient ratio and the caseload were found to be influencers of implementation outcomes [56, 61] such as fidelity. These findings corroborate our results. Our study further shows that most HIV clinics without the TB screening questionnaire on-site had low level of adherence adhere to the guidelines for implementing the intervention. This finding is consistent with the Global Fund 2018 report on best practices on TB case finding and treatment which indicated that the absence of TB screening questionnaire at the point of service delivery is a possible hindrance to screening PLHIV, TB cases identification and TB outcomes improvement [62]. Availability of guidelines promotes a step-by-step process to a successful implementation of health intervention [63]. Van de Glind et al. (2015) report in their

multi-case study that availability of protocols, procedures and agreements supporting the implementation of the intervention influences adherence [54]. However, our study found that other resources such as availability of TB/HIV clinical manual, TB IEC manual and TB prevention and infection control guideline do not vary with the programme adherence levels.

Limitation

It is worth mentioning that albeit some promising findings in this study, it also has some limitations to be considered in the interpretation of the results. Firstly, due to our selection procedure, respondents were mostly proponents' heads of the facility. On the other hand, because of the role and experience in implementing the intervention, respondents were able to provide rather detailed answers to our questions. Secondly, a limitation of concern is the external validity of the findings. The study was conducted in 27 district hospitals, and it is unclear to what extent these findings can be generalised to other district hospitals in Ghana. All the same, it was a census-based survey of all the facilities that met our inclusion criteria. We interpret these data with caution. Also, the median as a cut-off to determine high or low adherence facility does not take into account the magnitude or the distribution of the score across the samples, but because the 27 facility adherence scores were not normally distributed the non-parametric test conducted was appropriate. Thirdly, it should be noted that this study did not investigate the patients' perspective. It would be valuable to add their contribution to the factors found in this study. Finally our calculated Cronbach's alpha were generally low. However, the components (ITCF and PRM) with low alpha (0.59 and 0.57 respectively) had a higher adherence score compared to the components (IPT and TIC) with high alpha (0.94 and 0.68 respectively). Although alpha is widely used, the low level observed in this study might either be due to low number of items measuring the specific component or probably not a good measure of internal consistency or reliability for the ITCF and PRM components in our study.

Conclusion

A majority of the district hospitals implemented the intervention guidelines as is. Adherence was higher for intensive case-finding among PLHIV and programme review meeting intervention components and lower for IPT initiation and TB infection control intervention components. The programme adherence level observed by the DHs may explain the low and fluctuating intervention outcomes observed over the past years. Evidence from our study confirmed an association between programme adherence level and facility characteristics related to *health facility utilization and staffing workload*, and *physical facilities and resources*.

We recommend that NTP must highlight and reemphasize the importance of implementing the activities of these components fully through meetings, trainings and engagements. This could improve adherence for IPT initiation and TB infection control intervention components. Given the lack of programme adherence level studies, our study adds to implementation science literature a way of assessing adherence level by health facilities implementing an intervention.

Abbreviations

DHs: District Hospitals; HIV: Human Immuno virus; IPT: Isoniazid preventive therapy; IQR: Interquartile range; ITCF: Intensive TB case-finding among PLHIV; NACP: National AIDS/STI Control Programme; NTP: National Tuberculosis Control Programme; PLHIV: People living with HIV; PRM: Programme review meeting; TB: Tuberculosis; TIC: TB infection control; WHO: World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-021-07121-6.

Additional file 1.

Additional file 2.

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Authors' contributions

SN was primarily involved in the conception, study design, data collection, data cleaning, coding, analysis, and writing of the manuscript, TC and NK contributed to the conception, study design and critical review of the manuscript, EC and LI critically reviewed the manuscript while FB was involved in the conception, study design and data collection. The final manuscript had been read and approved by all.

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Availability of data and materials

The data on the facility level adherence to TB screening among PLHIV is accessible through supplementary material uploaded under supplementary file (filename: programmeresults). "Additional file 1" also uploaded under supplementary file (filename: additional file 1.docx) is a supplementary table providing descriptive information on the characteristics of the facility. Additional file 1" also uploaded under supplementary file (filename: additional file 1.docx) is a supplementary table providing descriptive information on the characteristics of the facility.

Declarations

Ethics approval and consent to participate

Ethical approvals were obtained from the University of the Witwatersrand, South Africa (M190110) and the Ghana Health Service in Ghana (GHS-ERC020/01/19). The NTP and all the ten Regional Health Directorate of the Ghana Health Service permitted the conduction of the study. Further

permission was obtained from the District Health Directorate before going to the DHs. With the head of the DHs being our respondents, we sought permission to conduct the study in the facility. Written informed consent was obtained from all the participants before interviews were conducted.

Consent for publication
Not Applicable.

Competing interests
The authors declare that they have no competing interests.

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References

1. Programme GT. Global tuberculosis report 2015 [Internet]. World Health Organization 20th ed.; 2015.
2. World Health Organization. Global Tuberculosis Report 2019 OMS – WHO. World Health Organization 1-2; 2019.
3. Biermann O, Lönnroth K, Caws M, Viney K. Factors influencing active tuberculosis case-finding policy development and implementation: a scoping review. BMJ Open. 2019;9(12):e031284. https://doi.org/10.1136/bmjopen-2019-031284.
4. WHO. WHO policy on collaborative TB/HIV activities Guidelines for national programmes and other stakeholders. 2012.
5. Ghana Health Service. Implementation of TB/HIV collaborative activities in Ghana: Joint programme planning policy and guidelines. 2014.
6. Habib AG. A clinical and epidemiologic update on the interaction between tuberculosis and human immunodeficiency virus infection in adults. Ann African Med. 2009;8:147–55 Medknow Publications and Media Pvt. Ltd.
7. Date A, Modi S. TB screening among people living with HIV/AIDS in resource-limited settings. JAIDS J Acquir Immune Defic Syndr. 2015; 68(Supplement 3):S270–3. https://doi.org/10.1097/QAI.0000000000000485.
8. WHO. Global TB Report. 2017;2018.
9. Owiti P, Onyango D, Momanyi R, Harries AD. Screening and testing for tuberculosis among the HIV-infected: outcomes from a large HIV programme in western Kenya 11 medical and health sciences 1117 public health and health services 11 medical and health sciences 1103 clinical sciences. BMC Public Health. 2019;19(1):29. https://doi.org/10.1186/s12889-018-6334-4.
10. Getahun H, Kittikraisak W, Heilig CM, Corbett EL, Ayles H, Cain KP, et al. Development of a Standardized Screening Rule for Tuberculosis in People Living with HIV in Resource-Constrained Settings: individual Participant Data Meta-analysis of Observational Studies. Murray M. PLoS Med. 2011;8(1):e1000391.
11. World Health Organization W. Global tuberculosis report 2018. p. 2018.
12. The Global Fund. Assessment and Best Practices of Joint TB and HIV Applications Progress, Challenges, and Way Forward Ela. Geneva; 2019.
13. CDC. Ghana Country Profile. 2019 [cited 2020 May 12]. Available from: https://www.cdc.gov/globalhivtb/where-we-work/region/westafrica/ghana/ghana.html
14. Ghana Health Service. Implementation of TB / HIV collaborative activities in Ghana: Technical policy and guidelines. 2007.
15. World Health Organization W. System screening for active tuberculosis: an operational guide. Geneva; 2015. (WHO/HTM/TB/2015.16)
16. Getahun H. Screening and diagnosing TB in PLHIV : challenges and ways forward collaborative TB / HIV activities; 2008.
17. Abebe R, Fentahun M, Haile Michael Y, Yizengaw M, Melkie M. HIV Testing and Counseling among Patients with Tuberculosis at Arbaminch Hospital, Southern Ethiopia. Biomed Sci Technol. 2014;8(5):232.
18. National AIDS/STI Control Programme. Ghana NACP Annual Report, 2019: National AIDS/STI Control Programme, Ghana; 2020.
19. Ho J, Fox GJ, Marais BJ. Passive case finding for tuberculosis is not enough. Int J Mycobacteriol. 2016;5(4):374–8. Elsevier Ltd. https://doi.org/10.1016/j.ijmyco.2016.09.023.
20. Proctor E, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, et al. Outcomes for implementation research : conceptual distinctions, Measurement Challenges , and Research Agenda. Adm Policy Ment Health. 2011:65–76.
21. Carroll C, Patterson M, Wood S, Booth A, Rick J, Balain S. A conceptual framework for implementation fidelity. Implement Sci. 2007;2(1):1–9. https://doi.org/10.1186/1748-5908-2-40.
22. Bahrami M, Deery C, Clarkson JE, Pitts NB, Johnston M, Ricketts I, et al. Effectiveness of strategies to disseminate and implement clinical guidelines for the management of impacted and unerupted third molars in primary dental care, a cluster randomised controlled trial. Br Dent J. 2004;197(11):691–6. https://doi.org/10.1038/sj.bdj.4811858.
23. College of Physicians R. National clinical guideline for stroke Fourth edition Prepared by the Intercollegiate Stroke Working Party. 2012.
24. Medicine AC of S. ACSM's Health/Fitness Facility Standards and Guidelines - American College of Sports Medicine - Google Books [Internet]. [cited 2020 Oct 27]. Available from: https://books.google.co.za/books?hl=en&lr=&id=DuN6DwAAQBAJ&oi=fnd&pg=PP1&dq=facility+guidelines&ots=VVGO-2hqhd&sig=dPZE-lonNF6THUmfHxsCrd3Ebns#v=onepage&q=facility guidelines&f=false.
25. Hughes CM, Lapane KL, Mor V. Influence of Facility Characteristics on Use of Antipsychotic Medications in Nursing Homes on JSTOR. Med Care. 38(12):1164–73.
26. Intrator O, Castle NG, Mor V. Facility Characteristics Associated With Hospitalization of... : Medical Care. Med Care. 37(3):228–37.
27. Lau DT, Kasper JD, Potter DEB, Lyles A. Potentially inappropriate medication prescriptions among elderly nursing home residents: their scope and associated resident and facility characteristics. Health Serv Res. 2004;39(5):1257–76. https://doi.org/10.1111/j.1475-6773.2004.00289.x.
28. Debara D. Factors affecting tuberculosis case detection in Kersa District, south West Ethiopia. J Clin Tuberc Other Mycobact Dis. 2017;9:1–4. https://doi.org/10.1016/j.jctube.2017.08.003.
29. City-Population. Ghana: Administrative Division (Regions and Districts) - Population Statistics, Charts and Map. 2019 [cited 2020 Jun 8]. Available from: https://www.citypopulation.de/en/ghana/admin/
30. Ghana Health Service. The health sector in Ghana: Facts and Figures. 2018 [cited 2020 Jan 15] Available from: https://www.ghanahealthservice.org/downloads/FACTS+FIGURES_2017.pdf.
31. Ghana Health Service. Implementation plan for IPT, Ghana. 2017 [cited 2018 Jul 24]. Available from: https://www.google.co.za/search?q=IPT+for+TB+prevention+in+Ghana&oq=IPT+for+TB+prevention+in+Ghana&aqs=chrome..69i57.12708j1j8&sourceid=chrome&ie=UTF-8.
32. Beehler GP, Funderburk JS, Possemato K, Vair CL. Developing a measure of provider adherence to improve the implementation of behavioral health services in primary care: a Delphi study. Implement Sci. 2013;8(1):19. https://doi.org/10.1186/1748-5908-8-19.
33. Becker DR, Smith J, Tanzman B, Drake RE, Tremblay T. Fidelity of supported employment programs and employment outcomes. Psychiatr Serv. 2001;52(6):834–6. https://doi.org/10.1176/appi.ps.52.6.834.
34. Abry T, Hulleman CS, Rimm-Kaufman SE. Using Indices of Fidelity to Intervention Core components to identify program active ingredients. Am J Eval. 2015;36(3):320–38. https://doi.org/10.1177/1098214014557009.
35. Durlak JA, DuPre EP. Implementation matters: a review of research on the influence of implementation on program outcomes and the factors affecting implementation. Am J Community Psychol. 2008;41(3–4):327–50. https://doi.org/10.1007/s10464-008-9165-0.
36. Backer TE. Finding the balance: program fidelity and adaptation in substance abuse prevention: a state-of-the-art review. Rockville, MD Cent Subst Abus Prev. 2002;
37. Ghana Health Service. Implementation plan for Isoniazid preventive therapy in Ghana. 2017.
38. Lebina L, Alaba O, Ringane A, Hlongwane K, Pule P, Oni T, et al. Process evaluation of implementation fidelity of the integrated chronic disease management model in two districts, South Africa. BMC Health Serv Res. 2019;19(1):1–14. https://doi.org/10.1186/s12913-019-4785-7.
39. StataCorp. Stata Statistical Software: Release 15. College Station: StataCorp LLC; 2017.

40. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ. 2011;2:53–5. https://doi.org/10.5116/ijme.4dfb.8dfd.
41. Spiliopoulou G. Reliability reconsidered: Cronbach's alpha and paediatric assessment in occupational therapy. Aust Occup Ther J. 2013;60(3):150–3. https://doi.org/10.1111/1440-1630.2012.00785.x.
42. Fagan JA. Treatment and Reintegration of Violent Juvenile Offenders: Experimental Results | Office of Justice Programs. Justice Q. 1990;7(2):233–63.
43. Aarons GA, Ehrhart MG, Farahnak LR, Sklar M. Aligning Leadership across Systems and Organizations to Develop a Strategic Climate for Evidence-Based Practice Implementation. Annu Rev Public Health. 2019;40:255–74. https://doi.org/10.1146/annurev-publhealth-030218-081759.
44. Aarons GA, Sklar M, Mustanski B, Benbow N, Brown CH. "Scaling-out" evidence-based interventions to new populations or new health care delivery systems. Implement Sci. 2017;12(1):111. https://doi.org/10.1186/s13012-017-0640-6.
45. Grimshaw J, Freemantle N, Wallace S, Russell I, Hurwitz B, Watt I, et al. Developing and implementing clinical practice guidelines. Qual Health Care. 1995;4:55–64. BMJ Publishing Group.
46. Wang Z, Norris SL, Bero L. Implementation plans included in World Health Organization guidelines. Implement Sci. 2016;11(1):76. https://doi.org/10.1186/s13012-016-0440-4.
47. Bellamstein SM, Gross D, Garvey CA, Hill C, Fogg L, Resnick B. Implementation fidelity in community-based interventions. Res Nurs Health. 2010;33(2):164–73. https://doi.org/10.1002/nur.20373.
48. Yano EM, Green LW, Glanz K, Ayanian JZ, Mittman BS, Chollette V, et al. Implementation and spread of interventions into the multilevel context of routine practice and policy: implications for the cancer care continuum. J Natl Cancer Inst Monogr. 2012;2012(44):69–89. https://doi.org/10.1093/jncimonographs/lgs004.
49. Fischer F, Lange K, Klose K, Greiner W, Kraemer A. Barriers and strategies in guideline implementation—a scoping review. Healthcare. 2016;4(3):36. https://doi.org/10.3390/healthcare4030036.
50. Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud P-AC, et al. Why Don't Physicians Follow Clinical Practice Guidelines? A Framework for Improvement. JAMA. 1999;282:1458–64.
51. Emmett ST, Haws S, Ringwalt CL, Vincus AA, Hanley S, Bowling JM, et al. Evidence-based practice in school substance use prevention: fidelity of implementation under real-world conditions. Health Educ Res. 2011;26(2):361–71. https://doi.org/10.1093/her/cyr013.
52. Howard AA, El-Sadr WM. Integration of tuberculosis and HIV Services in sub-Saharan Africa: lessons learned. Clin Infect Dis. 2010;50(5):738–44. https://doi.org/10.1086/650457.
53. Fleuren MAH, Paulussen TGWM, Dommelen P, Van Buuren S. Towards a measurement instrument for determinants of innovations. Int J Qual Heal Care. 2014;26(5):501–10. https://doi.org/10.1093/intqhc/mzu060.
54. Statistical Service Accra G. Ghana Demographic and Health Survey. 2014: 2015.
55. Nilsen P, Bernhardsson S. Context matters in implementation science: A scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. BMC Health Serv Res. 2019;19:189 BioMed Central Ltd.
56. Ana GA, Sile IE. Tuberculosis and HIV Integration in sub-Saharan Africa. Asian Pacific J Trop Dis. 2015;5(11):841–5. https://doi.org/10.1016/S2222-1808(15)60927-6.
57. Asamani JA, Ismaila H, Plange A, Ebey VF, Ahmed AAT, Chebere M, et al. The cost of health workforce gaps and inequitable distribution in the Ghana health service: an analysis towards evidence-based health workforce planning and management. Hum Resour Health. 2021;19(1):21–15. https://doi.org/10.1186/s12960-021-00569-3.
58. Imegbedion H, Imegbedion E, Peter A, Harry L. Perception of workload balance and employee job satisfaction in work organizations. Heliyon. 2020;6(12):e05780. https://doi.org/10.1016/j.heliyon.2020.e05780.
59. Lankhorst JA, Sheldon AT, Meyerrel A. Nurse staffing and healthcare outcomes: a systematic review of the international evidence. Adv Nurs Sci. 2005;28(2):163–74. https://doi.org/10.1097/00012272-200504000-00008.
60. Kane LR, Shamliyan AT, Muller C, Duval S, Wilt JT. The Association of Registered Staffing Levels and Patient Outcomes: Systematic Review and Meta-Analysis. Med Care. 45(12):1195–204.
61. Okot-Chono R, Mugisha F, Adatu F, Madraa E, Diodio M, Figueroa P. Health system barriers affecting the implementation of collaborative TB-HIV services in Uganda. Int J Tuberc Lung Dis. 2009;13(7):855–61.
62. The Global Fund. Best Practices on TB Case Finding and Treatment: Reflections and Lessons from West and Central Africa and Beyond. 2018.
63. Tesfaom A, Migwetti A. Implementing clinical guidelines: a need to follow recommendations based on the best evidence available Implementação de diretrizes clínicas: a necessidade de seguir recomendações com base na melhor evidência disponível. Rev Bras Epidemiol. 2018;21:180021.
64. Van De Glind I, Heinen M, Geense W, Meeuwes I, Wensing M, Van Achterberg T. Making the connection – factors influencing implementation of evidence supported and non-evaluated lifestyle interventions in healthcare: a multiple case study. Health Educ Res. 2014;30(6):521–41. https://doi.org/10.1093/her/cyv020.

Publisher's Note

Appendix C: Original paper 3

Factors influencing the implementation of TB screening among PLHIV in selected HIV clinics in Ghana: a qualitative study

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Abstract

Background: Decreasing the burden of TB among PLHIV through TB screening is an effective intervention recommended by the WHO. However, after over a decade of implementation in Ghana, the intervention does not realise the expected outcomes. It is also not well understood whether this lack of success is due to implementation barriers. Our study, therefore, sought to examine the factors influencing the implementation of the intervention among PLHIV attending HIV clinics at district hospitals in Ghana.

Methods: This was a qualitative study conducted from 6th to 31 May 2019 in three regions of Ghana. We conducted 17 in-depth interviews (IDIs – comprising 2 regional, 6 districts and 9 facility TB/HIV coordinators) and 8 focus group discussions (FGD – consisting of a total of 65 participants) with HIV care providers. All responses were digitally audio-recorded and transcribed verbatim for coding and analysis using the Framework Approach. Participants consented to the interview and recording.

Results: The main barriers to TB screening relate to the low commitment of the implementers to screen for TB and limited facility infrastructure for the screening activities. Facilitators of TB screening include (1) ease in TB screening, (2) good communication and referral channels, (3) effective goals and feedback mechanisms, (4) health workers recognising the need for the intervention and (5) the role of chemical sellers.

Conclusions: Key barriers and facilitators to the intervention are revealed. The study has shown that there is a need to increase HIV care providers and institutional commitment towards TB screening interventions. In addition, cost issues need to be assessed as they are drivers of sustainability. Our study also advances the field of implementation science through Consolidated Framework for Implementation Research (CFIR) to better understand the factors influencing the implementation.

Keywords: Barriers, Enablers, factors, TB screening, PLHIV, Ghana

Background

Even though much progress has been made in the fight against Tuberculosis (TB) and HIV coinfection globally, they continue to be the main public health threats and health systems concerns in many low- and middle-income countries [1,2]. The World Health Organization (WHO) global report on TB kept recognising TB as the main cause of ill-health and death among people living with HIV (PLHIV) worldwide, and especially in resource-challenged settings [3–5]. In fact, in 2018, about 17% (251,000/1,491,000) of TB related deaths were in PLHIV [6]. Notwithstanding, globally, the TB deaths among PLHIV had declined over time, by 44%, from 534,000 in 2000 to

300,000 in 2017 [7]. According to the same report, about 51% of reported TB cases were from PLHIV [7]. The impact of these two diseases has been immense on the performance of

health systems in poorly resourced countries and led to a reduction in global targets [8], particularly in sub-Saharan Africa [9].

Early diagnosis and effective treatment of TB cases in PLHIV can avert many deaths [7,10,11]. To end the dual epidemics of TB and AIDS by 2030, ensuring people are healthy and supporting the well-being of all TB and HIV patients is a prominent strategy of the WHO and Joint United Nations Programme on HIV/AIDS (UNAIDS) [7]. The WHO recommends the following three policy packages to control the TB/HIV burden: *(1)* establish the mechanism for collaboration between TB and HIV program activities; *(2)* reduce the burden of TB among PLHIV, and *(3)* decrease the burden of HIV among TB clients [12]. The second package – which is the focus of this study – is made up of three intervention groups termed as the Three I's specifically; intensify

TB case finding (ICF), isoniazid preventive therapy (IPT), and infection control for TB [12,13]. Among these interventions, the WHO recognised ICF, done through TB screening among PLHIV, as effective in reducing the burden of TB among PLHIV [13,14]. For example, in Ethiopia, TB screening effectively-identified 39% of PLHIV as presumptive TB cases, of which 6% were confirmed with Xpert machine [15]. ICF was defined as "the systematic identification of people with presumptive active TB, in a predetermined target group, using tests, examinations or other procedures that can be applied rapidly" [16]. For PLHIV, ICF would mean systematically screening for tuberculosis at every encounter with a health provider, among PLHIV, the high-risk population for HIV, or those living in mass population settings [17].

TB screening intervention ensures early detection of TB status followed by appropriate TB treatment or IPT among PLHIV [18]. Nonetheless, vast and persistent gaps exist in the detection and treatment of TB, including in PLHIV, especially in Sub-Saharan Africa [7]. For example, in 2017, only 64% of the estimated 10 million TB cases expected were reported, and most of the bottlenecks in detection and subsequent treatment of TB exist in the WHO Africa region where the burden of HIV co-infected with TB is highest [7].

Ghana adopted and implemented the TB screening intervention to reduce the burden of TB among PLHIV [19]. In the 2015 global TB report, Ghana was listed among the forty-one countries with TB/HIV co-infection burden with the highest estimated numbers of TB incidences that accounted for 97% of the global total [20]. In 2017, Ghana recorded an estimated TB incidence of 152 cases TB mortality of 36 per 100 000 population [21]. Also, in the same year, about 21% diagnosed with

TB had HIV [21]. Ghana started the TB screening of PLHIV in 2007, with plans to implement the IPT component in 2018. The intervention in Ghana is such that all PLHIV attending HIV clinics must routinely be screened for TB with the aid of a simple questionnaire approved by WHO. The WHO-approved four-symptom questionnaire asks PLHIV for the presence of cough of any duration, fever, weight loss, and night sweats [22]. The presence of one or more symptoms means a positive screening, which requires further TB confirmatory testing through Xpert MTB/RIF (*Cepheid, CA, USA*) [23–25] and other possible tests, including sputum smear microscopy, culture for *Mycobacterium tuberculosis* and chest X-ray [26,27]. Those with confirmed TB are put on appropriate TB treatment, while those without TB may be initiated on IPT when available [28].

A review of literature on program indicators for Ghana shows that during the early stages (from

2008 to 2012) of the implementation of the TB screening intervention, a high proportion of PLHIV (70% – 96%) were screened for TB at HIV care clinics [29]. Unfortunately, this observed success has not been sustained as programme data further revealed that in the years 2013 and 2014, approximately 20% [29] and 59% [30] of PLHIV, respectively, were screened for TB as part of care. Moreover, between 2010 and 2014, no clear screening target was set. The guideline, as a result, was revised in 2014 with new TB screening targets set at 56% for 2015, and progressively increasing the target to 80% in 2018 and further progress to 90% in 2020 [29]. But in 2018 and 2020, 40% and 44% TB screening coverage were achieved, respectively, far below the annual target. Such slow and fluctuating progress and not sustaining coverage in Ghana is unknown since no research has been conducted to that effect. Implementation science is crucial in identifying and addressing implementation gaps when evidence-based interventions are delivered into routine practice. Such identified gaps can inform appropriate strategies for successful implementation. Despite over a decade that the TB screening intervention has been implemented in Ghana, little information is known about factors that influence its implementation. Hence, the current research has the potential of addressing this gap. To the best of our knowledge, this marks the first study to examine the factors (barriers and facilitators) influencing the implementation of TB screening among PLHIV with the WHO approved questionnaire.

Our study was guided entirely by the Consolidated Framework for Implementation Research (CFIR) [31], one of the many determinant frameworks available for understanding contextual and other factors influencing the implementation of intervention of proven effectiveness [32]. It is a comprehensive framework in implementation science [31]. It was developed to guide the successful implementation of interventions through ascertaining factors that may influence the implementation of the TB intervention in a given setting. This could help identify potential strategies for overcoming any challenges before the implementation.

The CFIR comprises five domains: intervention characteristics, outer setting, inner setting, characteristics of individuals, and implementation process. The process domain entails planning, engaging, executing, and reflecting and evaluation that can only be ascertained in either a spiral or incremental approach to the implementation process [31], e.g., using the plan-do-study-act method through observation. Considering the focus of our study, we are therefore unable to include the process domain. We, therefore, chose the domains which were relevant and feasible to assess in the context of our study, defined as follows[31,33–35]:

1. *Intervention characteristics*: features of the TB screening intervention that may influence its effective implementation in Ghana. It comprises its perceived internal or external origin, evidence quality and strength, relative advantage, complexity and cost.
2. *Outer setting*: concerns with external influences (factors outside the HIV care clinics) on implementation of TB screening comprising availability of resources, incentives, communication and networking among HIV care clinics in Ghana.

3. *Inner setting*: relates to characteristics within the health facilities delivering the intervention. These include stakeholders, compatibility and relative priority of the TB screening intervention, goal-setting and feedback and the implementation climate.

4. *Individuals' characteristics*: concerns with health care providers and TB/HIV coordinators personal factors that may affect the implementation of the TB screening intervention. It consisted of health care providers' knowledge, beliefs, age, and years of practising and professional background.

Methods

Aim and design

We conducted an exploratory and purely qualitative study using in-depth interviews (IDIs) and focus group discussions (FGDs) on understanding the barriers and facilitators of implementing the

TB screening intervention among PLHIV attending HIV clinics in the Northern, Eastern and Central regions of Ghana. The CFIR [31] guided the design, interview guides, data collection and analysis and reported in line with the Standard for Reporting Qualitative Research (SRQR) [36].

Setting of the study and the intervention

This study is part of a more extensive study conducted in Ghana. Ghana has ten traditionally administrative regions. The regions are subdivided into 216 districts, with most districts having a district hospital. There were 144 district hospitals, out of which 100 had HIV clinics while conducting this study. The national TB program plan was to initiate IPT among PLHIV with a negative TB screen at HIV clinics in Ghana, and 27 district hospitals were earmarked to start the implementation, after which it would be scaled up to other district hospitals [19] as described and published elsewhere [37,38]. Therefore, the main study was conducted in the 27 district hospitals across all the regions. Also, the ten regions were grouped into three ecological zones (Savannah,

Forest and Coastal). One region was randomly selected from each zone to conduct this study. Therefore, this study was conducted in the three chosen randomly regions and their respective districts and district hospitals that were part of the extensive study (the 27 district hospitals).

The National Tuberculosis Programme (NTP) designed the TB screening intervention and implemented it through a cascading process at the regional, district, and facility levels and coordinated by TB/HIV collaborative committees. At each level, a TB/HIV coordinator was

appointed "to be responsible for the day to day running of programme implementation and oversight of TB/HIV collaborative activities" [29]. At the same time, the healthcare providers at the HIV clinics deliver the intervention to PLHIV.

Characteristics of the interviewees, recruitment, and sample selection

We gathered information from TB/HIV coordinators and HIV care providers. Based on the threezone of Ghana, we randomly selected one region from each of the zones to make up three regions. All the districts and district hospitals that were part of the more extensive study were involved in this study. We purposively selected the regional, district and facility TB/HIV coordinators to conduct IDIs to elicit information mainly at the facility level while HIV healthcare providers working in the HIV clinics for at least one year were selected to conduct FGDs to gather information at the provider level. Healthcare providers who did not provide direct care to PLHIV and unavailable TB/HIV coordinators at the research time were excluded. The head of the field team selected participants with support from colleagues and the head of HIV clinics in the case of the FGDs.

Pre-informatory letters were sent to the selected region and districts directors of health services and the facilities involved, informing them of the study. Potential participants were noted and approached on the day of the data collection. Participants were recruited based on availability, especially for the FGDs and interview appointments were explicitly booked for the IDIs when an eventuality occurred. All the participants consented before participation. In all, 17 TB/HIV coordinators (2 regional, 6 district and 9 facilities) and 65 HIV healthcare providers were included.

Data collection

IDI and FGD guides were developed based on the four domains in the CFIR framework that we had identified to apply to our study. The IDI guide partly focused mainly on the characteristics of individuals' domains which relates more to the provider level. The FGD guide also concentrated on the inner setting domains, which relate to the facility level. In addition, both guides also covered the intervention characteristics and outer setting domains. Fact-to-face IDIs were conducted with TB/HIV coordinators and FGDs with HIV healthcare providers.

Three field officers (4 members per team) worked in one region each to collect data for this study.

The teams had 5-days of practical training, including role-play on the IDI and FGD guides. The IDIs and FGDs were conducted in English and audio-recorded using digital voice recorders under the permission and consent of the participants. The FGDs were between 7 – 10 participants, depending on availability. Interviews and discussions were held in isolated, convenient and conducive places to ensure privacy. Interview recording times ranged from about 45 minutes to about 70 minutes. Data collection was from 6th to 31st May 2019.

The audio-recorded interviews and discussions were transcribed verbatim for analysis. SNB listened to the audiotapes, compared them with the transcripts and edited them when needed

to ensure the transcripts had the same information as the audiotapes. The audio recording was also used to fill in gaps in the notes. SAO reviewed and imported the transcripts into MaxQDA Analytics Pro Software 2020 for coding based on the CFIR. To ensure anonymity, responses from study participants, unique numbers had been assigned to participants and were used when presenting quotes from each respondent under the result section.

Data analysis

The study's data was analysed by SNB and SAO using the Framework Approach [39], which applies both inductive and deductive methods. The framework approach involves six iterative steps being (1) familiarisation with the data, (2) generating initial codes or assignment of primary codes to the dataset to describe the content, (3) searching for patterns and codes across the different interviews, (4) codes revision, (5) codes definition and (6) producing the report through the interpretation of results was adopted. The inductive method involved steps 1 and 2, while the deductive method involved steps 3 to 6. The codes were discussed and compiled into a codebook to guide the coding and categorisation of the data. The deductive analysis approach involved coding units of data according to the CFIR, with themes categorised based on defined factors (barriers or facilitators).

On the other hand, the inductive approach was used to identify new themes or unexpected findings aside from the CFIR through coding and categorisation. The transcripts were coded in MAXQDA Analytics Pro Software 2020 using the codebook developed. During the coding process, the emerging themes were linked to four domains of CFIR.

Ethical considerations

This study which is part of a large project obtained ethical approval from the University of the

Witwatersrand, South Africa (ref: M190110) and the Ethical Review Committee of the

Ghana Health Service (ref: GHS-ERC002/01/19). All procedures involving human

participants performed in this study were in accordance with the ethical standards of the

institutional and national research committee and with the 1964 Helsinki Declaration and its

later amendments or comparable ethical standards.

Results

Characteristics of Participants

Table 1 summarises the total number of participants recruited from the randomly selected three (Northern, Eastern and Central) regions. We conducted 17 IDIs with TB/HIV coordinators from these three regions. Additionally, we conducted eight FGDs with HIV care providers from eight IHV clinics, respectively. A total of 65 HIV healthcare providers participated in the eight FGDs.

Table 1: Total number of enrolled participants from the Northern, Central and Eastern regions

Participants	Type of data collection	Savannah Zone	Forest Zone	Coastal Zone	Total
Regional TB/HIV coordinators	In-depth interview (IDI)	0	1	1	2
District TB/HIV coordinators	In-depth interview (IDI)	1	2	3	6
Facility TB/HIV coordinators	In-depth interview (IDI)	2	4	3	9
HIV care providers	Focus group discussion (FGD)	2	3	3	8
HIV care providers	Number of participants for the FGD	14	29	22	65

Table 2 displays the background characteristics of the participants involved in the study. Out of the 17 IDIs conducted, 2 (12%) were regional, 6 (35%) were district, and 9 (52%) were facility TB/HIV coordinators, respectively. Most of the TB/HIV coordinators who participated in the IDI were males (n=11, 65%), while 6 (35%) were females. They age from 27 to 59 years old. And have worked for between 2 to 20 years, with over 82% having tertiary, while about 17% postsecondary non-tertiary education level. On the other hand, out of the 65 FGD participants, 39

(60%) were females, and their ages ranged from 24 to 59 years old. Most of them were clinicians (nurses) and had worked in an HIV clinic for between 1 to 15 years. Among the FGD participants, about 55% had attained tertiary, 39% had post-secondary non-tertiary, and 6% had upper secondary level of education.

Table 2: Background characteristics of study participants

Characteristics	**Number (%), median (range)**	
	FGD (n=65)	IDI (n=17)
Sex		

Female Male	39 (60.0) 26 (40.0)	6 (35.3) 11 (64.7)
Age (median, range)	32 (24 – 59)	37 (27 - 59)
Level of education Upper secondary Post-secondary non-tertiary Tertiary	 25 (38.5) 4 (6.1) 36 (55.4)	 0 3 (17.6) 14 (82.4)
Profession Clinician Non-clinician	 39 (60.0) 26 (40.0)	 - -
Years working (median, range)	3 (1 – 15)	6 (2 – 20)

Factors influencing the implementation of TB screening among PLHIV

The themes emerging from our data were linked to the four domains of the CFIR (Table 3). The study has shown that barriers to TB screening include lack of commitment of health workers to screen HIV clients, limited or lack of privacy and space allocated for TB screening activities. Further, the enablers of TB screening relate to ease in TB screening, good communication, and networking between colleagues within the HIV clinic and within the facility. Other enablers included stakeholder engagements, good referral channels and health workers recognising the need for the intervention. These are described in detail in the following section.

Table 3: Emerging barriers and facilitators linked to CFIR domains

Domain	**Themes**	
	Facilitators	**Barriers**
Intervention characteristics	Ease of TB screening tool	Transport costs for sputum collected
	Goals setting, feedback and supervision	
Outer setting	Good referral relationships	
	Chemical sellers key in community case finding	

Inner setting	Renovations and innovations	Limited or lack of privacy and inadequate space to conduct TB screening
Individual characteristics	Acceptability of intervention among providers	A low commitment of care providers

Intervention Characteristic

In exploring the features of the intervention that might influence or impede the implementation of the TB screening intervention at the HIV clinic, our study found factors such as ease of the TB screening, and goal setting, feedback and supervision as facilitators. In addition, aside from the facilitators related to the intervention characteristics domain found, some barriers such as transport cost for sputum collected were identified. These facilitators and barriers found are presented below.

Ease of TB screening

Across our in-depth interviews and focus group discussions held, it was evident that the TB screening intervention was not challenging to implement. In exploring the complexity of TB screening, all the participants in the study stated that it was not complicated.

> "…the screening itself is not complicated" – *FGD with HIV care providers group 7*

> "The screening, for us, it is not complicated"- *IDI with Facility TB/HIV Coordinator 1*

> "It is not complicated because if you take a good look at the screening tool it has all the questions you need to ask the client so it makes it easy" - *FGD with HIV care providers group 5*

Goals setting, feedback and supervision

National targets drive TB screening. However, the providers set facility-specific annual targets of cases to screen and detect from the interviews and discussions. Implementation of the intervention is monitored through monthly or quarterly reports from the providers to the district coordinators.
In addition to the reports, the coordinators embark on quarterly field visits. During such visits, the patients are interviewed to verify the implementation of the intervention. This was perceived as a facilitator to implementation.

> "We go on supportive supervision…There is also a database for reporting. Through that database, we are also able to monitor what they [providers] are doing, give feedback and discuss issues… When we go on monitoring and supervision we look at their data and interview some of the patients and they attest to the fact that they[patients] have been screened for TB and the data that they [providers] have also shown that they [providers] have been screening the patients for TB*"- IDI with Regional TB/HIV Coordinator 1*

District-level reports are prepared and sent to regional and national offices for dissemination and further decision making. There are also validations and peer reviews of reports. The care providers agreed that the feedback they receive "are helpful because you see where you have gotten to, and you see where your lapses are and where you have to put in more effort to improve." – *IDI with Clinic head*

Transport costs for sputum collected

The project's activities are decided and budgeted for at the national level. Therefore, the region or the district works with the budget line given them by the national program. The care providers stated that donors essentially bear the cost of TB screening. The main cost incurred by the providers is transportation costs for sputum transfer. This cost is seldom reimbursed, and, in many cases, the refunds are delayed. Therefore, the health workers bear the transportation cost.

> "When you screen somebody we have to take it to the lab and someone has to take transport to this place, if they have motor bicycle they have to fuel it. If the facility does not have motor bicycle then they have to pay for transportation. Some money comes for sputum transport but it is not enough as compared to the number of sputum that we have to pick from all the areas to the lab. So sometimes they incur so much money and what we do is that we place a book at the lab so anyone who brings samples to the hospital, they will write their names. So when money comes for sputum transfer we just share it for them but the money is not enough" - *IDI with District TB/HIV Coordinator 4*

> "The cost incurred includes the cost of transporting samples to the teaching hospital. We have to send samples to Cape Coast Teaching Hospital for culture "-*IDI with Facility TB/HIV Coordinator 1*

Outer setting

In exploring factors outside the HIV care hospitals, it emerged during our FGDs and IDIs that interactions with care providers in other facilities, referral relationships, and chemical sellers' roles were facilitators to the TB screening intervention, as discussed in detail below.

Referral relationships

The providers explained that their clinics relate with or network with their colleagues in other facilities who also implement TB screening intervention among PLHIV. The networks involve liaising with them, referring cases to them, discussing complex case management, sharing resources, and attending training and workshops. The care providers added that the relationship and collaboration between the districts and their respective facilities are excellent.

> "We have the Genexpert. We are the only facility that has it in the whole Tamale

> Metropolis and they [other HIV clinics] all come to use it. They have our phone numbers. They call us as they come here to take their results from us … they come here, they bring their clients to us... we have a WhatsApp group so we are always in contact. So we have a network and the network is really strong and because we have each other's numbers, anytime there is a problem, it's easier for us to communicate and assist each other." – *IDI with facility TB/HIV Coordinator 9*
>
> "With the HIV clinic we collaborate, when you come and you have HIV, we screen you for TB, you have TB we screen you for HIV, it is like our one-stop shop. We just do everything for you but if you have to be referred, you are referred" - *IDI with Facility*
>
> *TB/HIV Coordinator 7*

Chemical sellers key in community case finding

The district-level coordinators added that chemical sellers were essential stakeholders because they are the first point of call within the communities. Chemical sellers are the first point of care, especially when people experience mild symptoms of illness. During our interviews, our participants confirmed the role of these chemical sellers in TB case finding in the communities.

> A coordinator stated that "when somebody is coughing, the first point of call will be the chemical seller to get some medication. So we work with them, from time to time we meet them and we discuss how they can link those cases to us so that together we help the patients" – *IDI with district TB/HIV Coordinator 4*
>
> "The chemical sellers...because that is the first point of call, they are very important to case finding and screening so we always engage them."- *IDI with district TB/HIV Coordinator 2*

Characteristics of individuals

The characteristics of the individuals involved in the implementation were explored to identify their influence on the conduct of the TB screening intervention. As presented below, we found the acceptability of TB screening intervention among providers as facilitators and lack of commitment of care providers as a barrier that influences the implementation.

Acceptability of intervention among providers

The intervention is also widely accepted among care providers. In all the facilities involved in the study, the providers acknowledge the need for TB screening among PLHIV. They added that the intervention is good and advantageous to PLHIV. Therefore, the intervention is important and needful because it will help in the early detection and treatment of new cases.

"…HIV clients are prone to get TB…so there's a need to screen them to know their status." – *IDI with facility TB/HIV Coordinator 6*

"Yes, there is the need because every person living with HIV must be tested for TB because if they are tested and they are active or positive, they can be put on drugs so that they are treated or they are cured on the TB" – *FGD with HIV care providers Group 8*

Low commitment of care providers

Although generally, the health workers have accepted the need and relevance of the intervention, some health workers' attitudes towards the intervention were perceived as a barrier to implementation. Health workers carry out TB screening; therefore, their commitment or otherwise will directly affect the success of the intervention. Our participants alluded to the fact that a major problem is the willingness of some care providers to implement the intervention.

"I think it's the human factor. The will to want to implement the tool is the problem… but it's the commitment."- *IDI with Facility TB/HIV Coordinator 9*

"The steps are not cumbersome but then, it is the support that is not coming from the facility level, you only ask for cough, that is the cardinal sign but then the commitment is not there on behalf of the health workers"- *IDI with Regional TB/HIV Coordinator 2*

"Screening is not anything difficult but I think, because of the infectious nature of TB, most of the people don't want to involve themselves in it"- *IDI with District TB/HIIV Coordinator 3*

Inner setting

The participants highlighted internal factors such as space, privacy, renovations and innovations as key determinants to TB screening. These infrastructural and structural changes within the HIV care clinics are further elaborated on below.

Privacy and space

According to the participants, lack of privacy and inadequate space at the TB/HIV care units within the hospitals/clinics is a potential barrier to TB screening. Congested spaces allocated to TB screening also pose a threat to the providers' health. Other providers mentioned that they did not have a laboratory for their collected samples. They added that these issues hindered the smooth implementation of TB screening for PLHIV. For example, during a focus group discussion, it emerged that "privacy is a paramount problem in our unit, the place is always choked." – *FGD with HIV care providers Group 9*

"The unit we have for both TB and HIV clients is very small because both of them come to the same place on the same days for medication, screening and other activities… the place is even congested, their confidentiality is at stake" - *FGD with HIV Care providers group 3*

Renovations and innovations

The providers also reported that there had been changes in some health facilities to enable TB screening activities among PLHIV. These changes included creating additional rooms for TB/HIV activities, introducing new HIV registers, electronically capturing patients' data, and acquiring other screening equipment. The providers also explained that these alterations help in implementing the intervention.

> "…there is a new HIV register. Unlike the former one where it was not clearly [stated] in it, it was not enforced whether the HIV client has been screened for TB unless in the folder but this time around, in the folder, in the register, [and] on the e-tracker, it demands that.
> And that will encourage, it will push service providers to pay more attention to TB screening..." – *IDI with TB/HIV Coordinator 3*

> "…introduction of the screening tool is helping the work… the x-ray is also helping with the screening and at the lab we have the gene expect that is also helping to detect cases, so policy-wise I think that is where the nation is now, trying to use the best of equipment to get the best of result." – *FGD with HIV care providers Group 6*

Discussion

The ultimate goal of TB case-finding and treatment is to cure the individual who has the disease, decrease its spread to other persons, mitigate death and avert disease-associated disability. Therefore, when cases are unidentified, treatment initiation is impossible. Not treating infected persons and noncompliance to TB treatment exposes the treatment cascade to failure, relapse and drug resistance with its associated complications [40]. The current study is critical as it reveals the existing factors (barriers and enablers) implementing TB screening among PLHIV in Ghana.

The emerging barriers and facilitators fall under the four domains explored in the study. Barriers to TB screening emerged from individual characteristics (i.e. low commitment of health workers) and inner setting (i.e. facility space and privacy allocated for screening activities). Facilitators of TB screening (emerging from all four domains) include (1) ease in TB screening, (2) good communication and referral channels, (3) effective goals and feedback mechanisms, (4) health workers recognising the need for the intervention and (5) the role of chemical sellers.

In this study, the commitment of health workers towards the intervention is a barrier to implementation. In clinics where the workforce is lax and partially involved in the screening process, the outcome of the intervention is also affected. Low commitment of health workers

towards TB control practices was cited by Tamir et al. (2016) as a barrier to achieving outcomes. This was purported to have been caused by many health workers' lack of motivation and interest in the intervention. Also, the health workers not being reimbursed for going the extra mile to transport sputum samples out-of-pocket affects the sustainability of implementing TB screening among PLHIV.

Given that one of the facilitators for TB screening was recognising the need for the intervention incentivising health workers for incidental costs incurred and continuous engagement with them through training workshops [41] is plausible to drive commitment towards effective implementation. Cost is a primary driver of sustainability. Therefore, a broader dialogue on the cost of TB screening and its accompanying resources is needed, especially in this era of a global Covid-19 pandemic. Resource limitations re-directed and limited donor aids will leave some interventions strained, and TB is no exception. Tamir et al. (2016) also noted that renovations and other structural changes were not done due to financial constraints [42].

Quite relative to the involvement of health workers is the risk associated with screening, sputum collection and care of TB patients in congested spaces [42]. The staff-patient ratio aggravates the situation in these HIV clinics, where space and privacy are compromised because of resource constraints. In similar studies in Nigeria and China, the health workers adopted ways to keep their consulting and treatment areas well ventilated to control the spread of TB. Some health workers expressed concern over their health and safety, considering TB's contagious [43,44]. Addressing issues of space will boost the commitment and implementation drive for TB screening activities [45]

Our study also revealed that TB screening and case finding cascade includes informal players such as chemical sellers. As noted above, chemical sellers are stakeholders in Ghana's health system and mediate social behaviours of health [46]. This group of 'treatment outlets' offer treatment options to TB patients and help mainstream health workers detect cases. Therefore, there is a need to constantly engage and liaise with the chemical sellers to effectively implement TB screening through active case finding [47]. Networking and communication among health workers through sharing testing equipment and social media platforms like WhatsApp have offered collaboration opportunities for TB screening and case detection. The TB treatment chain has equally been strengthened through these internal and external support structures that the health system has. This provides an opportunity for driving implementation using these facilitators. Overall, the implementers noted that the TB screening intervention among PLHIV attending HIV clinics was important and necessary in reducing or decreasing the burden of TB in HIV clients in Ghana.

Strength and limitation

Our study is the first to document the factors that influence the implementation of TB screening among HIV clients in Ghana. Also, a fundamental implementation outcome – fidelity – is unpacked from an implementer's perspective to shed light on inherent, latent and apparent factors that determine the extent to which the TB screening intervention is carried out in HIV clinics in Ghana. Our study also utilised a combination of robust implementation frameworks to explore TB screening in Ghana holistically. This has allowed for an unconventional approach to identifying implementation bottlenecks and advantages that researchers, implementers, and policymakers can leverage to reach Ghana's optimum TB care targets.

The main limitation of our study is that only seven providers participated in some of the FGD, which violates the minimum number required for an FGD. Nonetheless, we found energetic interactions among participants in such discussions, which led to stimulations and providing firsthand information and new ideas from the HIV healthcare providers.

Conclusion

Our study presents critical points for the TB/HIV community despite the above limitations. First, our work shows that although there are barriers to implementing TB screening among PLHIV in HIV clinics in Ghana, the enablers or facilitators would contribute to case identification and eventually treatment of TB among PLHIV. Second, there is evidence of an overall recognition of the need for the intervention. Third, there is also a need to: (1) strengthen commitment of health workers; (2) address space constraints at the HIV clinics (3) deliberately and constantly engage other influential stakeholders such as chemical sellers and (3) explore sustainable ways for caring for this vulnerable population beyond donor support, especially during the Covid-19 pandemic when economies are under pressure to thrive, and foreign aids are gradually diminishing or being re-directed. Finally, our study showed that there are more facilitators to leverage to achieve successful implementation and optimal coverage of TB screening among PLHIV in Ghana.

This study may also provide relevant insights to engage with Ghana Health Services in developing the intervention to ensure outcomes from this study are utilised.

List of abbreviations

HIV – Human Immunodeficiency Viruses

PLHIV – People living with human immunodeficiency viruses

TB – Tuberculosis

ART – Antiretroviral therapy

IDI – In-depth Interview

FGD – Focus Group Discussion

T&T – Travel and Transport

CWC – Child welfare clinic

ANC – Antenatal Care

Declarations

Ethical approval and consent to participants

We obtained ethical approvals for the main study from both the Human Research Ethics

Committee (Medical) of the University of the Witwatersrand, Johannesburg, South Africa

(Clearance number M190110) and the Ghana Health Service Ethical Review Committee (GHSERC), Accra, Ghana (clearance number GHS-ERC002/01/19). In addition, permission to access the various sites were obtained from the respective administrations (regional, district and facility). Again, written informed consent was ontained from each of the study participants before conducting the interview or discussion.

Consent for publication

Not required.

Data availability

The interview and discussion guides used to collect data for this study has been uploaded under supplementary file with the filename “additional file1.docx”.

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Author contributions

SNB as a graduate student is an early career epidemiologist, data analyst and implementation science researcher. SNB and the field officers had no affiliation with study sites at the time of the research; hence the responses from the interviews and discussions are a true reflection of the participants and not a result of previous contacts. FB was then the programme manager of NTP, but there was no direct contact at the data collection, which could have influenced the responses.

The rest of the authors had no previous connection with the sites. MK is a public health practitioner interested in implementing science and health policy and systems strengthening research. SAO is a young career implementation science researcher interested in neglected tropical diseases and health systems research using qualitative research methods. LI is a demographer interested in implementation science, while TC is a biostatistician and public health researcher interested in implementation science. All authors are vested in qualitative research.

Competing interests

The authors declare that they have no competing interests.

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References

1. Ansa GA, Walley JD, Siddiqi K, Wei X. Assessing the impact of TB/HIV services integration on TB treatment outcomes and their relevance in TB/HIV monitoring in Ghana. Infect Dis Poverty. 2012;1(1):1.

2. Biermann O, Tran PB, Forse RJ, Vo LNQ, Codlin AJ, Viney K, et al. Capitalising on facilitators and addressing barriers when implementing active tuberculosis case-finding in six districts of Ho Chi Minh City, Vietnam: a qualitative study with key stakeholders. Implement Sci. 2021;16(1):1–12.

3. The Global Fund. Best Practices on TB Case Finding and Treatment Reflections and Lessons from West and Central Africa and Beyond. 2018.

4. The Global Fund. Assessment and Best Practices of Joint TB and HIV Applications Progress, Challenges, and Way Forward itle). Geneva, Switzerland; 2019.

5. World Health Organisation. TB Treatment and care. 2019.

6. Kanabus A. Information about Tuberculosis [Internet]. GHE. 2020 [cited 2020 Aug 28]. p. www.tbfacts.org. Available from: https://tbfacts.org/tb-statistics/

7. World Health Organization W. GLOBAL TUBERCULOSIS REPORT 2018. 2018.

8. Pawlowski A, Jansson M, Sköld M, Rottenberg ME, Källenius G. Tuberculosis and HIV Co-Infection. Hobman TC, editor. PLoS Pathog. 2012 Feb 16;8(2):e1002464.

9. WHO. Global TB Report 2017. 2018.

10. Dusenbury L, Brannigan R, Hansen WB, Walsh J, Falco M, Ghana NACP, et al. Quality of implementation: developing measures crucial to understanding the diffusion of preventive interventions. Who. 2014 1 June;15(1):1–9.

11. Saunders MJ, Tovar MA, Collier D, Baldwin MR, Montoya R, Valencia TR, et al. Active and passive case-finding in tuberculosis-affected households in Peru: a 10-year prospective cohort study. Lancet Infect Dis. 2019 1 May;19(5):519–28.

12. Getahun H, Van Gorkom J, Harries A, Harrington M, Nunn P, Perriens J, et al. INTERIM
POLICY ON COLLABORATIVE TB/HIV ACTIVITIES. TB/HIV Research FoundationRegional Office for Africa South Africa). Paul Nunn Paul Pronyk; 2004.

13. WHO. WHO policy on collaborative TB/HIV activities Guidelines for national programmes and other stakeholders. 2012.

14. Owiti P, Onyango D, Momanyi R, Harries AD. Screening and testing for tuberculosis among the HIV-infected: Outcomes from a large HIV programme in western Kenya 11 Medical and Health Sciences 1117 Public Health and Health Services 11 Medical and Health Sciences 1103 Clinical Sciences. BMC Public Health. 2019 8 January;19(1):29.

15. Adelman MW, McFarland DA, Tsegaye M, Aseffa A, Kempker RR, Blumberg HM. Costeffectiveness of WHO-Recommended Algorithms for TB Case Finding at Ethiopian HIV Clinics. Open Forum Infect Dis. 2018;5(1).

16. World Health Organization W. System screening for active tuberculosis: an operational guide. Geneva, Switz. 2015;(WHO/HTM/TB/2015.16).

17. Kranzer K, Houben RM, Glynn JR, Bekker LG, Wood R, Lawn SD. Yield of HIVassociated tuberculosis during intensified case finding in resource-limited settings:

a systematic review and meta-analysis. Vol. 10, The Lancet Infectious Diseases. Elsevier; 2010. p. 93–102.

18. Dabaro D. Factors affecting tuberculosis case detection in Kersa District, South West Ethiopia. J Clin Tuberc Other Mycobact Dis. 2017 1 December;9:1–4.

19. Ghana Health Service. Implementation plan for IPT, Ghana [Internet]. 2017 [cited 2018 Jul 24]. Available from:

https://www.google.co.za/search?q=IPT+for+TB+prevention+in+Ghana&oq=IPT+for+T
B+prevention+in+Ghana&aqs=chrome..69i57.12706j1j8&sourceid=chrome&ie=UTF-8

20. World Health Organization W. Global Tuberculosis Control. 2009.

21. CDC. Ghana Country Profile [Internet]. 2019 [cited 2020 May 12]. Available from: https://www.cdc.gov/globalhivtb/where-we-work/region/westafrica/ghana/ghana.html

22. Getahun H, Kittikraisak W, Heilig CM, Corbett EL, Ayles H, Cain KP, et al. Development of a Standardised Screening Rule for Tuberculosis in People Living with HIV in Resource-Constrained Settings: Individual Participant Data Meta-analysis of Observational Studies. Murray M, editor. PLoS Med. 2011 Jan 18;8(1):e1000391.

23. World Health Organization. Treatment of tuberculosis: guidelines. 4th ed. Geneva, Switzerland: WHO/HTM/TB; 2009. 420 p.

24. Automated Real-time Nucleic Acid Amplification Technology for Rapid and Simultaneous Detection of Tuberculosis and Rifampicin Resistance: Xpert MTB/RIF System Policy Statement WHO Library Cataloguing-in-Publication Data Policy statement:

automated real-time nucleic acid amplification technology for rapid and simultaneous detection of tuberculosis and rifampicin resistance: Xpert MTB/RIF system. 2011.

25. Programme GT. Automated real-time nucleic acid amplification technology for rapid and simultaneous detection of tuberculosis and rifampicin resistance: Xpert MTB/RIF

assay for the diagnosis of pulmonary and extrapulmonary TB in adults and children. 2013.

26. World Health Organization. WHO | World Health Statistics 2015. WHO. 2016;

27. Falzon D, Schünemann HJ, Harausz E, González-Angulo L, Lienhardt C, Jaramillo E, et al. World Health Organization treatment guidelines for drug-resistant tuberculosis, 2016 update. Eur Respir J. 2017 Mar 1;49(3).

28. World Health Organisation. Guidelines for intensified tuberculosis case-finding and isoniazid preventive therapy for people living with HIV in resource-constrained settings. Geneva; 2011.

29. Ghana Health Service. Implementation of TB/HIV collaborative activities in Ghana: Joint programme planning policy and guidelines. 2014.

30. Rediet Abebe, Mistre Fantahun, Yirgalem HaileMichael MY and MM. HIV Testing and Counseling among Patients with Tuberculosis at Arbaminch Hospital, Southern Ethiopia. Biomed Sci Technol. 2014;

31. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice : a consolidated framework for advancing implementation science. 2009;15:1–15.

32. Nilsen P, Bernhardsson S. Context matters in implementation science: A scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. Vol. 19, BMC Health Services Research. BioMed Central Ltd.; 2019. p. 189.

33. Safaeinili N, Brown-Johnson C, Shaw JG, Mahoney M, Winget M. CFIR simplified: Pragmatic application of and adaptations to the Consolidated Framework for Implementation Research (CFIR) for evaluation of a patient-centered care transformation within a learning health system. Learn Heal Syst. 2020 26 January;4(1).

34. Keith RE, Crosson JC, O'Malley AS, Cromp D, Taylor EF. Using the Consolidated Framework for Implementation Research (CFIR) to produce actionable findings: a rapidcycle evaluation approach to improving implementation. Implement Sci. 2017 Dec 10;12(1):15.

35. VanDevanter N, Kumar P, Nguyen N, Nguyen L, Nguyen T, Stillman F, et al. Application of the Consolidated Framework for Implementation Research to assess factors that may influence implementation of tobacco use treatment guidelines in the Viet Nam public health care delivery system. Implement Sci. 2017 Dec 28;12(1):27.

36. O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. Standards for reporting qualitative research: A synthesis of recommendations. Acad Med. 2014;89(9):1245–51.

37. Narh-Bana SA, Kawonga M, Chirwa, Esnat D LI, Bonsu F, Chirwa TF. Fidelity of implementation of TB screening guidelines by health providers at selected HIV clinics in Ghana. 2021;(135):1–21.

38. Narh-Bana SA, Chirwa TF, Chirwa ED, Bonsu F, Ibisomi L, Kawonga M. Adherence of HIV clinics to guidelines for the delivery of TB screening among people living with HIV / AIDS in Ghana. 2021;9:1–13.

39. Gale, Nicola K; Heath, Gemma; Rashid, Sabina; Redwood S. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. BMC Med Res Methodol. 2013;13(117):260–1.

40. Osei E, Oppong S, Adanfo D, Doepe BA, Owusu A, Kupour AG, et al. Reflecting on tuberculosis case notification and treatment outcomes in the Volta region of Ghana: a retrospective pool analysis of a multicentre cohort from 2013 to 2017.

41. Getnet F, Hashi A, Mohamud S, Mowlid H, Klinkenberg E. Low contribution of health extension workers in identification of persons with presumptive pulmonary tuberculosis in Ethiopian Somali Region pastoralists. BMC Health Serv Res. 2017;17(1):1–9.

42. Tamir K, Wasie B, Azage M. Tuberculosis infection control practices and associated factors among health care workers in health centers of West Gojjam zone, Northwest Ethiopia: a cross-sectional study. BMC Heal Serv Res 2016 161. 2016 Aug;16(1):1–11.

43. He GX, Hof S van den, Werf MJ van der, Wang GJ, Ma SW, Zhao DY, et al. Infection control and the burden of tuberculosis infection and disease in health care workers in china: a cross-sectional study. BMC Infect Dis. 2010 Oct;10:313.

44. LU O, JN C, KA U, PG O, CD N. The status of tuberculosis infection control measures in health care facilities rendering joint TB/HIV services in "German Leprosy and Tuberculosis Relief Association" supported states in Nigeria. Niger J Clin Pract. 2011 Jul;14(3):270–5.

45. Ayakaka I, Ackerman S, Ggita JM, Kajubi P, Dowdy D, Haberer JE, et al. Identifying barriers to and facilitators of tuberculosis contact investigation in Kampala, Uganda: A behavioral approach. Implement Sci. 2017;12(1):1–13.

46. Bonsu F, Hanson-Nortey N, Afutu F, Dzata F, Ahiabu M, Chimzizi R, et al. The National Tuberculosis Health Sector Strategic Plan for Ghana 2015-2020. 2014.

47. Biermann O, Lönnroth K, Caws M, Viney K. Factors influencing active tuberculosis casefinding policy development and implementation: A scoping review. BMJ Open. 2019 Dec 11;9(12):e031284.

Appendix D: Original paper 4

Weighted fidelity of delivery of an intervention in the health facility: a case of TB screening among PLHIV in selected hospitals in Ghana

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Abstract

Background

Implementation outcome assessment such as fidelity is essential in implementing health intervention. Limited studies that have been conducted have assessed fidelity separately at the

healthcare provider level or facility level with managers. However, there might be variations in facility resources and their utilization, skewing such comparisons. We, therefore, would like to investigate whether a combined provider-facility level fidelity is a more effective assessment. We aim to describe the weighted fidelity of implementing the guidelines for TB screening among PLHIV and examine its effect on TB screening coverage at selected HIV clinics in Ghana.

Methods

We used cross-sectional study and collected data from 226 HIV care providers and 27 managers of district hospitals implementing the TB screening intervention at the HIV clinics. We also extracted information from TB registers monthly for 2018. Weighted fidelity was measured based on the extent to which the intervention was implemented, considering both the facility and the provider level assessments. Response scores and extracted data on fidelity were analyzed and summarized using the median and inter-quartile range for non-normal data such as fidelity scores and coverage and frequencies and percentages for categorical data such as resources availability.

Linear regressions models were fitted for TB screening coverage using the fidelities separately.

Results

The study revealed that the weighted fidelity median score was 67% (IQR: 59.9 – 74.9%), and the TB screening coverage was 71.3% (IQR: 56.9 – 96.7). Weighted fidelity of delivery was statistically associated with TB screening coverage ($p<0.01$). All the moderating factors investigated have no statistical association with weighted fidelity of delivery ($p>0.05$) except for IE&C. Facilities with TB IE&C materials available had a significantly ($p=0.025$) higher median fidelity score 75.4% (74.9 – 88.5) than their counterparts 65.7% (59.4 – 72.6).

Conclusions

The combined provider-facility level assessment of fidelity demonstrated that weighted fidelity of delivery is positively associated with TB screening coverage and provided a better platform for assessing implementation fidelity. It also showed that the availability of IE&C materials significantly moderates the weighted fidelity of delivery. Weighted fidelity is an efficient way of holistically assessing fidelity within health facilities.

Keywords Composite, weighted, fidelity of delivery, TB screening, facilities, Ghana

Background

Programme implementation is vital in achieving and strengthening desired health intervention results. Effective implementation of an intervention at a health facility requires combined multisectoral effort, i.e. it relies on both the facility managers, the health care providers or workers and facility resources for the intervention to improve health outcomes. A review of several health care interventions implemented within health facilities revealed that the programmers had provided guidelines for management and core implementers (health workers) to aid implementation [1,2]. For example, the policy guideline for conducting TB screening among PLHIV attending HIV clinics in Ghana contained specific guidelines and activities to be provided by the facility as a unit and another set of policies and activities to be delivered by the health worker for the intervention to be successfully implemented in the facility [3]. However, there exists little information on the extent of holistic implementation of the intervention.

Most studies assessed fidelity of delivery separately, either at the facility level or the provider level. However, there might be variations in facility resources which might skew the comparison. Though the provider level or facility level adherence or fidelity provides an important measure for identifying specific components for implementation improvement and tracking the progress, they fail to provide an easily accessible picture of the performance of the implementation [4] on an intervention outcome. According to the Institute of Medicine (IOM) [5], combined measures are an aggregation of individual performance measures into a

summary score, thereby reducing the amount of data to be processed, leading to a clearer picture of overall fidelity. It serves multiple purposes, including the "provision of a summary of the extent to which management has created a "culture of excellence" and designed processes to ensure high performance in delivering services throughout the organization, benchmarking of organization's performance against high-performing organizations and to monitor changes over time, tracking a particular components' performance, providing performance criteria to use in selecting high-performing facility, and for identifying high-performing facilities which can then be studied to identify characteristics that distinguish them from lower-performing facilities" [4].

Implementation science research assessments of health interventions revealed that interventions are mostly not delivered as designed by the intervention's designers. This is referred to as implementation fidelity or adherence to the delivery [6–8]. As discussed earlier, some of these studies assessed fidelity of delivery from either the health workers' perspective [9] or the facility (managers') perspective [10]. Weighted fidelity to combine both are lacking in the implementation science literature. The term weighted fidelity is used in this study as an umbrella to refer to the combination of whether the facility managers adhere to protocol guidelines of the implementing the TB screening intervention at the facility and whether the HIV healthcare provider adheres to the clinical guidelines and activities for delivering the intervention as is. Weighted fidelity, a composite measure, is essential to fully understand the extent of implementation to maximize the potential for effectiveness and relate to observed intervention outcomes.

Implementation fidelity (including 'weighted' fidelity) is a component of process evaluations [11,12], which documents whether the intervention activities have been delivered as intended and resulted in a separate output [12,13]. Process evaluation may be conducted periodically at any phase of the intervention evaluation [14] by reviewing the activities and output components to assist stakeholders in seeing how the intervention is performing. That is, the assessment can be done at the feasibility, effectiveness or implementation stages. Weighted fidelity of delivery is a complex mix of health providers' and facility managers' adherence. The TB screening activities from the providers' level will have to be aggregated at the facility level and combined with the facility managers' TB screening implementation activities. Studies have proposed and used different evaluation methods to fully understand the extent of the implementation [14]. Mixed methods evaluations had been proposed by some studies [15,16]. Other studies also proposed quantitative methods through observation and self-

reporting [14], recording of sessions, transcription, and rating a random proportion against a checklist [8,17] to assess fidelity of delivery. Irrespective of all these approaches, multiple methods have been recommended to overcome the limitation of the individual methods [18–21]. They proposed that more consideration on the choice of method should be placed on the resources available for conducting the study and the context in which the study is to be undertaken. Quantitative approach through self-reported and record reviews work alternatively well when the research is resource-constrained and if stigmatization was going to be an issue especially when observation was going to be a paramount choice of method. This latter approach also provides in-depth understanding of the factors influencing fidelity [21] and is able to relate fidelity of delivery to intervention outcomes observed.

Fidelity of delivery occurs within the implementation process [11] to achieve intervention outcomes. The extent of full delivery of the intervention is also influenced by some factors including availability of resources, health workers, workspace, etc. [22]. To take the complexities of the fidelity assessments and its related factors into account, a theory needs to include factors that potentially influence fidelity and the components for determining fidelity. Many frameworks to assess fidelity exist. One such integrated framework is the Conceptual Framework for Implementation Fidelity by Carroll et al. [23].

Carroll et al.'s [23] framework provides guidance to measure fidelity and its related factors. The framework proposed that the relationship between the implementation of evidence-based intervention and its outcome may be influenced by fidelity (the extent to which the intervention is delivered as is). They proposed further that "the measurement of implementation fidelity is the measurement of adherence, i.e., how far those responsible for delivering an intervention actually adhere to the intervention as its designers outline it. Adherence includes the sub-categories of content, frequency, duration and coverage (i.e., dose). The degree to which an intervention's intended content or frequency is implemented is the degree of implementation fidelity achieved for that intervention. The level achieved may be influenced or affected, (i.e., moderated) by certain other variables: intervention complexity, facilitation strategies, quality of delivery, and participant responsiveness" Finally, according to Carroll et al. [23], when the critical components of an intervention are identified and implemented well, then an implementation said to be successful.
The framework provides a systematic method that can be used to assess fidelity and its related factors and has previously been used in different sectors of life [23,24]. However, to the best of the authors' knowledge, no research had ever assessed weighted fidelity of

delivery. Therefore, this study extends previous research by using a systematic approach to advance initial strategies that could be used to improve fidelity assessment in the health sector.

The strategies outlined in this paper are to be well-thought-out within the context of TB screening among PLHIV attending HIV clinics in Ghana. TB screening is an early TB detection strategy aimed at decreasing the burden of TB in PLHIV and AIDS. The technical policy and guidelines for TB/HIV collaboration in Ghana spelt out various activities and guidance to pursue at multiple facilities. The TB screening intervention was to be carried out "as part of the health sector response to the intersecting TB and HIV epidemics (sector-wide approach –SWAP), and as part of the essential health care package (EHP) in Ghana" [3]. The intervention consisted of standard components delivered by the facility managers and components provided to all HIV clients by the HIV health worker. Details of the intervention components for the managers are reported in the facility level fidelity paper [10], while that of the HIV care providers are reported in the provider level fidelity paper [9].

Utilizing the Conceptual Framework for Implementation Fidelity, this study aimed to demonstrate one way in which fidelity can universally be assessed to improve intervention outcomes. The paper specifically aimed to:

1. Assess weighted fidelity of delivery to the intervention
2. Identify factors influencing weighted fidelity of delivery, and
3. Relate the weighted fidelity scores with the respective TB screening coverage.

Methods

Setting of the study

Details of the study area are published elsewhere [9,10], but briefly, it was conducted in 27 district hospitals with functioning HIV clinics in Ghana. These hospitals are located across the length and breadth of the country.

Study design and participants

The study was cross-sectional and descriptive in design. It used a census-based approach with a structured questionnaire to conduct face-to-face interviews with the study participants in the selected district hospitals.

The district hospitals included in the study were identified as facilities having both geneXpert and X-ray machines as a requirement to have begun the initiation of IPT in TB confirmed negatives in HIV clients in 2017 [25]. Therefore, the participants were the head of the health facility (in the absence of the TB/HIV coordinator or the in-charge of the HIV clinic in interviewed) for the facility level and HIV care providers for the provider level. Successful intervention implementation requires the health facilities to deliver specific guidelines and activities to enable the HIV healthcare providers to implement the intervention among the PLHIV attending the HIV clinic.

Description of Intervention

The intervention assessed in this study is TB screening among PLHIV attending HIV clinics in Ghana. In 2004, based on the dual effect of TB and HIV on the individual and the nation, the WHO released a collaborative policy guideline for member countries with the challenge to adopt. Ghana recognized active TB case-finding as one of the best ways to decrease the burden of TB in PLHIV hence it adopted the WHO TB/HIV collaborative policy guidelines and implemented the intervention in 2007 [26]. The Ghana National Tuberculosis Control Programme (NTP) and the National HIV/AIDS Control Programme (NACP) designed the intervention [26]. The intervention aimed at reducing the burden of TB among PLHIV required TB screening for all HIV clients attending HIV clinics and initiating appropriate treatment. In addition, the guidelines spelt out explicit activities to be undertaken by the facility as an entity and other activities undertaken by HIV care providers.

In the policy guidelines [26], facilities are to ensure:

1. The facility regularly runs an HIV clinic daily except weekends
2. They conduct an intensive TB-case finding among PLHIV attending the HIV clinic
3. TB infection control at the facility
4. Review meetings are held regularly.

While HIV care providers are to ensure:

1. Every HIV client visiting the HIV clinic is screened for TB using the TB screening tools
2. TB awareness through education and counselling for all HIV clients attending HIV clinic

Interventionist

They included the facilities as an entity and the HIV healthcare providers working at the HIV clinic within the district hospitals. The designed guidelines and activities to be delivered by the facility managers to ensure the intervention is implemented within the facility is referred to as facility level. On the other hand, the designed clinical guidelines and activities for the intervention to be implemented by the healthcare providers is referred to as the provider level. Delivery of the guidelines and activities at the facility level is as important as delivering the intervention guidelines at the provider level.

Implementation measures

The core features of the programme guidelines and clinical guidelines were identified from the guideline with guidance from the CFIF. Two semi-structured questionnaires were developed specifically for the study based on the core features identified to measure the weighted fidelity of delivery. One of the questionnaires contained all the components for the facility level, while the other had all the components for the provider level.

The key components of the programme guidelines of the intervention to be delivered at the facility level were identified and operationalized. The component covered content, frequency, and coverage constructs that Carroll et al. (2017) identified in their CFIF. Questions were measured differently. Some were measured either as 1=yes, activity performed, 0=no, an activity not performed, others measured on a scale of 1 to 3 (1=not adherent, 2= partially adherent and 3= fully adherent). Others were measured with a 3-Likert scale where 1=one day a week, 2=2-4 days a week and 3=every day of the working days. Others were measured on a 5-Likert scale (1=annually, 2=half yearly/bi-annually, 3=quarterly, 4= monthly, 5=weekly).

The key components in the clinical guidelines for the providers to deliver the intervention were also identified and grouped under content and frequency constructs in the CFIF. Most of the factors were measured similar to the programme factors. Other factors were measured on a scale of 1 to 4, with 4 being the highest response.

Data Sources

We conducted a face-to-face interview with facility managers on how the facility level components were delivered and with HIV healthcare providers on the extent of delivery of the activities at the provider level. In addition, we extracted data from the HIV and TB registers to assess TB screening coverage and workload.

Statistical analysis

Assessing a weighted fidelity as a combined measure of provider level and facility level items requires a valid and reliable approach by which measurement data may be aggregated and used to provide information of facility performance based on a single quality score.

The Premier, Inc. and the Centers for Medicare and Medicaid Services (CMS) launched the Hospital Quality Incentive Demonstration Project (HQI) to measure facility performance and pay incentives to top-performing participating hospitals.

We modified the CMS HQI Demonstration Composite Quality Score Methodology by incorporating TB screening guidelines as items to calculate our weighted fidelity score for each participating facility. The TB screening Weighted Fidelity Score is comprised of two separate components: a provider level items response scores and a facility level items response scores. Figure 1 illustrates the steps in calculating the weighted fidelity score for one health facility. First, we accounted for the relative contribution of the number of items for each component by applying proportional weighting values. For instance, the provider level components account for sixteen of the items, therefor a weight factor of 0.457 (16/35) is used. Similarly, the facility level component is weighted 0.523 (19/35). Next, the weighted fidelity score was calculated after the weights were applied to the components using the formula below:

Weighted fidelity score = **p***composite provider level fidelity score + **(1-p)***composite facilitylevel fidelity score, where p is the weight factor.

Privider level data			
	Facility 1		
	Item	Max score	Actual score
Provider 1	Asks client about cough of any duration	1	1
	Asks if client had fever	1	1
	provides education	1	1
	How frquently do you provide education for PLHIV	5	4
	.		
	.		
	.		
	Total per provider	48	43

Items for implementing the intervention by providers are aggregated to the provider level

Aggregated at facility level		
	Max. Score	Actual score
Provider 1	48	43
Provider 2	48	33
Provider 3	48	38
.	.	.
.	.	.
.	.	.
.	.	.
Provider n	48	
Total per facility	384	304

Provider level values are aggregated to the facility level

Weighted fidelity score				
Providers aggregated at the facility level				
Max. Score	Actual score	Provider rat	Provider items weight	provider score
384	304	0.792	0.457142857	0.361905
Facility level data				
Max. Score	Actual score	Facility rate	Facility items weight	facility score
29	17	0.5862069	0.542857143	0.318227
Universal fidelity score per facility				0.680131
			100*0.680131 =	68.01%
Weighted fidelity score = P*provider score + (1-p)*facility score				
where p is the weight factor				

Figure 1: Sample weighted implementation fidelity score calculation for one health facility

Median with interquartile range (IQR) was presented for continuous variables and frequencies with percentages for categorical variables. In addition, the frequency distribution of the facilities' background factors, the distribution of fidelity scores by facility, and the overall weighted fidelity were reported. Having calculated the fidelity scores and establishing non-normality of the outcome variable (fidelity scores), Mann-Whitney test, Kruskal-Wallis test and Spearman's correlation coefficient were used to compare scores across facility factors.

Finally, we examined the value of the combined fidelity by fitting and comparing three models with TB screening coverage as an outcome. Each model separately included either the

provider or facility or the combined fidelity adjusting for the facility level factors assessed in this study, including ecological zone, availability of TB screening tools, TB/HIV clinical manual, screening guideline, workload etc. The R-squared, adjusted R-squared, Root Mean Square Error (RMSE), F-test and the p-value associated with the t-stats were presented. All analyses were performed in STATA version 15 at a 5% significance level.

Results

Table 1 presents the frequency distribution of background factors of the 27 participating health facilities. Geographically, 7 (26%) of the HIV clinics were located in the Savannah zone, 11 (41%) in the Forest zone, and 9 (33%) in the Coastal Zone. The study showed that most facilities have the resources and materials required for conducting the TB screening. For instance, 20 (74%), 23 (85%), 21 (78%), 40 (89%), and 23 (85%) have TB screening tool, TB/HIV clinical manual, TB screening guidelines, TB IE&C materials, and TB prevention and infection control guideline available in the facility respectively.

Table 1: Distribution of background factors of the selected HIV clinics

Variable	Value	Frequency (%)
Ecological zone	Savannah	7 (26)
	Forest	11 (41)
	Coastal	9 (33)
TB screening tool available	Yes	20 (74.1)
	No	7 (25.9)
TB/HIV clinical manual available	Yes	23 (85.2)
	No	4 (14.8)
TB screening guideline available	Yes	21 (77.8)
	No	6 (22.2)
TB IE&C materials available	Yes	24 (88.9)
	No	3 (11.1)
TB prevention and infection control guideline available	Yes	23 (85.2)
	No	4 (14.8)
Number of HIV healthcare providers per HIV clinic	Median (IQR)	9 (8 – 10)

Number of PLHIV attending the HIV clinic per month	Median (IQR)	609 (182 – 1479)
Number of PLHIV screened for TB per month	Median (IQR)	352 (112 – 1479)
Number of patients per provider per month	Median (IQR)	66.7 (18.3 – 127.9)

The study also found that the median number of HIV care providers per HIV clinic was 9 (IQR: 8 – 10), while the median number of patients per provider per month was 66.7 (IQR: 18.3 – 127.9).

In order to conduct further analysis, reliability checks were carried out to examine the validity and reliability of the instruments used. To do this, we used Chronbach's Alpha to examine the provider level construct, and the facility level construct. Our finding showed that all the Alpha values of the constructs examined were greater than the recommended value [27]

Fidelity scores and related factors of the weighted fidelity score

Table 2 presents the fidelity score from the separate level and the facility factors associated with the weighted fidelity score. The fidelity scores for the facility and healthcare providers were assessed separately and the weighted fidelity score. At the provider level, we found the median fidelity score to be 79% (IQR: 58.3, 100.0), with some providers scoring 16% and others scoring as high as 100%. While at the facility level, the median fidelity score was 62.1% (IQR: 58.6 – 65.1), ranging from 48.3% to 82.8%. On the other hand, we found that the median of the weighted fidelity score was 67% (IQR: 59.9 – 74.9%).

Table 2: Distribution of weighted fidelity scores by facility characteristics

Variable	Value	Weighted fidelity score Median (IQR)	*p* value
Ecological zone	Savannah	74.7 (63.7 – 76.4)	0.417
	Forest	66.0 (56.3 – 70.5)	
	Coastal	65.3 (59.9 – 74.9)	
TB screening tool available	Yes	67.2 (56.3 – 74.9)	0.740
	No	66.4 (62.7 – 75.4)	
TB/HIV clinical manual available	Yes	75.6 (69.3 – 82.4)	0.101
	No	66.0 (58.9 – 73.5)	
TB screening guideline available	Yes	66.8 (63.7 – 74.9)	0.448
	No	63.0 (56.3 – 71.7)	
TB IE&C materials available	Yes	75.4 (74.9 – 88.5)	**0.025**
	No	65.7 (59.4 – 72.6)	
	Yes	75.6 (69.3 – 82.4)	0.101

TB prevention and infection control guideline available	No	66.0 (58.9 – 73.5)	
Number of HIV healthcare providers per HIV clinic		66.7 (59.9 74.9)	0.687
Number of PLHIV attending the HIV clinic per month		66.8 (59.9 – 74.9)	0.862
Number of PLHIV screened for TB per month		66.8 (59.9 – 74.9)	0.490
Number of patients per provider per month		66.8 (59.9 – 74.9)	0.869
		Median score (IQR)	
Screening coverage		71.3 (56.8 – 96.7)	-
Facility fidelity		62.1% (IQR: 58.6 – 65.1)	-
Provider fidelity		79% (IQR: 58.3, 100.0)	-
Weighted fidelity	-	66.8 (59.9 – 74.9)	-

In terms of facility factors associated with weighted fidelity, Table 2 shows a statistically significant difference in the median weighted fidelity scores by the availability of TB IE&C materials in the facility. Facilities with TB IE&C materials available had significantly ($p=0.025$) higher median weighed fidelity score (75.4% (74.9 – 88.5)) than their counterparts (65.7 (59.4 – 72.6)). The rest of the factors, including the ecological location of the facility, availability of TB screening tools, and the number of clients seen at the HIV clinic per month, do not show statistically significant differences in the median weighted fidelity scores. See Table 2.

Comparing the fit of the three different fidelity models

Three independent models were fitted for the TB screening coverage using the separate fidelities (provider, facility and weighted) as the main indicator controlling for the facility level factors assessed in this study. The statistics for evaluating the fit of the different regression models are presented in Table 3. The provider and the weighted fidelities were are significant predictors of TB screening coverage ($p<0.05$), but facility fidelity was not ($p>0.05$). The study shows from the calculated R-squared that 56.8%, 80.4%, and 86.8% of the variance in the TB screening coverage can be explained by facility, provider, and weighted fidelities, respectively. Also, from the adjusted R-squared, the models indicated that about 77.1% of the TB screening coverage was explained by the weighted fidelity model followed by 66.1% by the provider fidelity model and then 25.1% by the facility fidelity model after adjusting for the factors in the model. Table 3 further showed that the weighted

fidelity (p<0.001) models provider fidelity (p<0.001) model were highly statistically significant while the facility fidelity (p=0.1457) model was not statistically significant.

Table 3: Model statistics assessing the fidelity type in relation to screening coverage

Model (Fidelity type)	P-value	R-Squared	Adjusted R-Squared	P-value (Ftest)	RMSE
Provider	0.000	0.8045	0.6611	0.0013	11.552
Facility	0.085	0.5677	0.2507	0.1457	11.178
Weighted	0.000	0.8680	0.7712	0.0001	9.4915

RMSE=Root Mean Square Error. The models were adjusted using facility-level factors assessed.

Weighted fidelity score and coverage HIV clinics

The study found that the median score for the TB screening coverage was 71.3% (IQR: 56.9 – 96.7). The minimum coverage was 41.3% for some facilities, while some other facilities scored the maximum of 100%. Figure 2 displays a comparison between weighted fidelity score and TB screening coverage from the selected HIV clinics implementing the TB screening intervention among PLHIV. The study further showed that high weighted fidelity scores were associated with much higher TB screening coverage and vice versa. For instance, facilities with a weighted fidelity score of 66.8% or 81.6% had TB screening coverage of 78.4% or 91.0%, respectively. Also, facilities with a weighted fidelity score of 51.1% or 60.0% ascertained TB screening coverage of 41.3% or 43.7%. A very high statistical association between the weighted fidelity score and TB screening coverage was therefore observed (p<0.01) in our study.

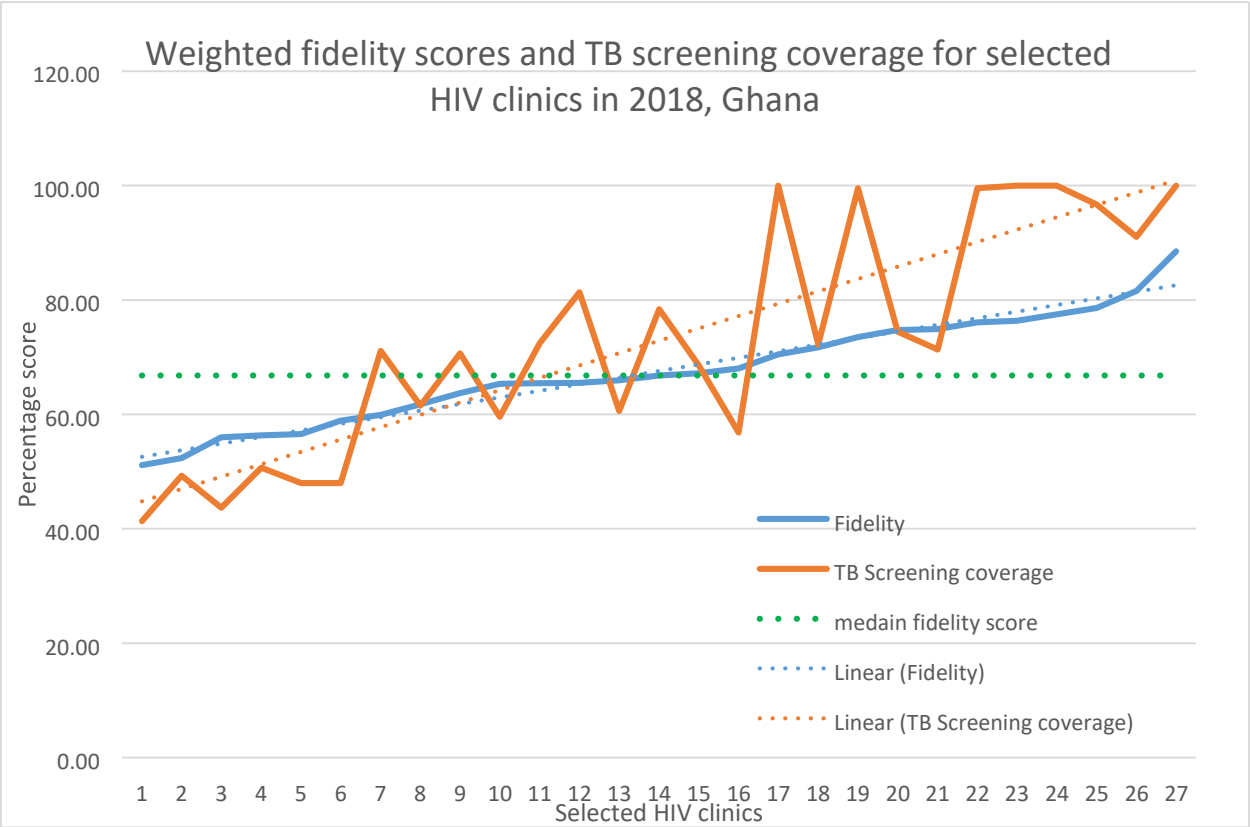

Figure 2: Weighted fidelity score and TB screening coverage in selected HIV clinics

Discussion

Weighted fidelity as a composite measure aggregates performance measures from different levels within a system into summary scores, minimizes voluminous data and produce a clearer, easily accessible and understandable overview of the overall performance of the implementation process. The observed results of the study have provided support for the validity of the instruments developed and the combined analysis adopted to examine the weighted fidelity of delivery of the TB screening intervention. The reliability of the provider level constructs and the facility level constructs were confirmed through the well-known and accepted statistical test, Cronbach Alpha, and all the Alpha values exceeded the recommended values in the literature [27–29]

In this study of 27 selected district hospitals and 226 HIV healthcare providers screening for TB among PLHIV attending the HIV clinics within the district hospitals, we characterized all facilities using provider-level and facility-level data to generate a weighted fidelity score. The weighted fidelity score is a composite score of the two levels. We conducted a weighted fidelity analysis using these composite scores and found that about 51% of the health

facilities had their weighted fidelity scores above the median score. These data present further evidence that characterizing all facilities using a construct that classifies facilities as high or low weighted fidelity may be a helpful framework for categorizing facilities in terms of fidelity or adherence levels. Besides, in the separate analysis, the median fidelity score at the facility level was 62%, and the provider level was 79% compared to the median weighted fidelity score of 67%. After examining the fit and significance of the three models, we observed that the weighted fidelity model provides a better platform for assessing fidelity of delivery than the separate fidelities, especially the facility level. This was clearly shown by the R-squared values calculated in this study. In addition, the separate fidelities scores observed provided information on the extent of adherence at those specific levels. In comparison, the combined provided an overall picture of the extent of adherence to all the critical activities related to the implementation of the intervention.

The results of this study have provided support that weighted fidelity assessment is an important factor in assessing the extent to which an intervention is being implemented. The results indicated that provider, facility and weighted fidelity scores significantly and positively relate to TB screening coverage. Overall, weighted fidelity relates more strongly to the outcome than provider fidelities and facility. As the fidelity of delivery was very low, TB screening coverage in the intervention outcome was much lower. The study showed that, once fidelity is very high, an intervention is assured of achieving its desired result. This finding agrees with what Durlak and DuPre 2008 [30] found in the meta-analysis, which suggested that well-implemented interventions achieved more outstanding intervention outcomes than poorly implemented interventions. Many other implementation research projects have concluded similarly [23,31–33].

Surprisingly, the results obtained from this study demonstrated that only the availability of information education and communication (IE&C) materials and resources at the intervention site (HIV clinics) were found to influence weighted fidelity score significantly. That is, facilities with IE&C available had a higher weighted fidelity score than those who do not have those resources.

IE&C materials on an intervention help bring the understanding, awareness, provide information, and eradicate mythical beliefs of implementing an intervention [34]. However, most of the moderating factors assessed, including the availability of TB screening tool, TB/HIV clinical manual, and TB prevention and infection control guideline, the number of HIV healthcare providers per HIV clinic, the number of PLHIV attending the HIV clinic per

month, and staff workload did not significantly influence weighted fidelity of delivery in this study. Although there were no discernible differences in the weighted fidelity levels between the three zones due to limited sample size, the Savannah zone had the highest median weighted fidelity score compared to Forest and Coastal zones that had an almost similar median score

Contrary to the findings on moderating factors, in a separate analysis conducted at the facility level [10], resources such as availability of TB screening questionnaire and TB screening guidelines, and health facility utilization factors such as number of PLHIV attending HIV clinic per month and number of patients per provider per month significantly influence facility-level fidelity.

Limitation

Our findings should be considered with caution and may not be generalized. The number of health facilities involved in the study was too small, resulting in difficulties in conducting and interpreting results from some statistical tests with confidence. For instance, the unit of our analysis was the facility level which consisted of 27 facilities.

In addition to the small sample size possibly affecting our analysis, our study did not address the provider level moderating factors. Therefore, we cannot comment on whether any factor related to the provider influences the weighted fidelity of delivery.

Different weighing methods might require an understanding of the practical implications of the items to indicate how important they are in the construct. Some weighting approaches may introduce additional biases into the dataset if care is not taken. Hence, the weighting approach adopted for this study was appropriate and ensured the different levels of data were considered at an equal proportion. Also, the combined fidelity measure for each facility from the provider and facility perspective will aid internal facility fidelity improvement. Notwithstanding, we suspect that composite measures have identified some facilities as obtaining high weighted fidelity scores because those facilities were doing "reasonably well" across most of the component measures but not "well enough" to be high performers on those measures. More research to examine this hypothesis in future will be useful.

Conclusions

We conducted an implementation science study to assess fidelity by combining the components from the provider and facility levels. The study also aimed to understand the influence of facilitylevel moderating factors on weighted fidelity of delivering TB screening intervention among PLHIV attending HIV clinics in Ghana. The results indicated that weighted fidelity of delivery is an important factor and provides a better platform for assessing the implementations fidelity of the TB screening intervention among HIV clients. In addition, we found a positive linear relationship between weighted fidelity score and TB screening coverage. However, most of the moderating factors examined did not significantly influence the weighted fidelity of delivering the TB screening intervention among HIV clients, except IE&C. These results should be treated with caution due to limitations outlined earlier. Therefore, future studies should take into consideration these limitations.

List of abbreviations

CFIF: Conceptual Framework for Implementation Fidelity

HIV: Human Immuno virus

IE&C: Information, Education and Communication

IPT: Isoniazid preventive therapy

IQR: Interquartile range

NACP: National AIDS/STI Control Programme

NTP: National Tuberculosis Control Programme

PLHIV: People living with HIV

TB: Tuberculosis

WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Ethical approvals were obtained from the University of the Witwatersrand, South Africa (M190110) and the Ghana Health Service in Ghana (GHS-ERC002/01/19). The NTP and all the ten Regional Health Directorates of the Ghana Health Service permitted the conduction of

the study. Further permission was obtained from the District Health Directorate before going to the DHs. With the head of the DHs being our respondents, we sought permission to conduct the study in the facility. Written informed consent was obtained from all the participants before interviews were conducted.

Consent for publication

Not Applicable

Data availability

We used two different sets of data in this study. The first is the data on the facility level. The next is the data on the provider level, all accessible through supplementary material uploaded under supplementary file (filenames: facilityleveldata.dta and providerleveldata.dta). "Additional file 1", also uploaded under supplementary file (filename: additional file1.docx), is a supplementary table providing results of the multiple regression models with facility or the provider or the weighted fidelities.

Funding

The TDR funded this research project, the Special Programme for Research and Training in Tropical Diseases, hosted at the World Health Organization and co-sponsored by UNICEF, UNDP, the World Bank, and WHO. TDR grant number: B40299. First author ORCID iD: 0000-00018010-2673.

Authors' contributions

SN was primarily involved in the conception, study design, data collection, data cleaning, coding, analysis, and manuscript writing. TC and MK contributed to the conception, study design and critical review of the manuscript. EC, LI, and SO critically reviewed the manuscript while FB was involved in the beginning, study design and data collection. The final manuscript had been read and approved by all.

Competing interests

The authors declare that they have no competing interests.

Acknowledgements

We acknowledge the respondents from the 27 facilities where the study was conducted, Mr Gabriel Odonkor, Ms Ernestina Baaba Sam and Mrs Diana Narh-Bana, for their assistance. Also, the School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa, is acknowledged for the support.

References

1. WHO. WHO policy on collaborative TB/HIV activities Guidelines for national programmes and other stakeholders. 2012.
2. World Health Organization W. WHO | WHO Three' I's meeting: intensified case finding, isoniazid preventive therapy and TB infection control for people living with HIV. WHO. 2015;
3. Ghana Health Service. IMPLEMENTATION OF TB/HIV COLLABORATIVE ACTIVITIES IN GHANA : JOINT PROGRAMME PLANNING POLICY AND GUIDELINES IMPLEMENTATION OF TB/HIV COLLABORATIVE ACTIVITIES IN GHANA JOINT PROGRAMME PLANNING POLICY AND GUIDELINES. Accra; 2014.
4. Shwartz M, Restuccia JD, Rosen AK. Composite Measures of Health Care Provider Performance: A Description ofApproaches. Milbank Q. 2015 Dec 1;93(4):788.
5. Ring JC, Chao SM. Performance measurement: accelerating improvement. 2006.
6. Lorencatto F, West R, Christopherson C, Michie S. Assessing fidelity of delivery of smoking cessation behavioural support in practice. Implement Sci. 2013 Apr 4;8(1).
7. Lorencatto F, West R, Bruguera C, Michie S. A method for assessing fidelity of delivery of telephone behavioral support for smoking cessation. J Consult Clin Psychol. 2014;82(3):482–91.
8. Toomey E, Currie-Murphy L, Matthews J, Hurley DA. Implementation fidelity of physiotherapist-delivered group education and exercise interventions to promote

selfmanagement in people with osteoarthritis and chronic low back pain: a rapid review part II. Man Ther. 2015 Apr 1;20(2):287–94.

9. Narh-Bana SA, Kawonga M, Chirwa, Esnat D LI, Bonsu F, Chirwa TF. Fidelity of implementation of TB screening guidelines by health providers at selected HIV clinics in Ghana. 2021;(135):1–21.

10. Narh-Bana SA, Chirwa TF, Chirwa ED, Bonsu F, Ibisomi L, Kawonga M. Adherence of HIV clinics to guidelines for the delivery of TB screening among people living with HIV / AIDS in Ghana. 2021;9:1–13.

11. Lebina L, Alaba O, Ringane A, Hlongwane K, Pule P, Oni T, et al. Process evaluation of implementation fidelity of the integrated chronic disease management model in two districts, South Africa. BMC Health Serv Res. 2019 Dec 16;19(1):1–14.

12. Limbani F, Goudge J, Joshi R, Maar MA, Jaime Miranda J, Oldenburg B, et al. Process evaluation in the field: Global learnings from seven implementation research hypertension projects in low-and middle-income countries. BMC Public Health. 2019;19(1).

13. Sharma S, Adetoro OO, Vidler M, Drebit S, Payne BA, Akeju DO, et al. A process evaluation plan for assessing a complex community-based maternal health intervention in Ogun State, Nigeria. BMC Health Serv Res. 2017 Mar 28;17(1).

14. Walton H, Spector A, Tombor I, Michie S. Measures of fidelity of delivery of, and engagement with, complex, face-to-face health behaviour change interventions: A systematic review of measure quality. Br J Health Psychol. 2017 Nov 1;22(4):872–903.

15. Toomey E, Matthews J, Hurley DA. Using mixed methods to assess fidelity of delivery and its influencing factors in a complex self-management intervention for people with osteoarthritis and low back pain. BMJ Open. 2017 Aug 1;7(8).

16. Cooper C, O'Cathain A, Hind D, Adamson J, Lawton J, Baird W. Conducting qualitative research within Clinical Trials Units: avoiding potential pitfalls. Contemp Clin Trials. 2014;38(2):338–43.

17. Borrelli B. The assessment, monitoring, and enhancement of treatment fidelity in public health clinical trials. J Public Health Dent. 2011 Dec;71(SUPPL. 1).

18. McKenna JW, Flower A, Ciullo S. Measuring fidelity to improve intervention effectiveness. Interv Sch Clin. 2014 Jan 1;50(1):15–21.

19. Moncher FJ, Prinz RJ. Treatment fidelity in outcome studies. Clin Psychol Rev. 1991;11(3):247–66.

20. Munafò MR, Davey Smith G. Repeating experiments is not enough. Nature. 2018 Jan 25;553(7689):399–401.

21. Creswell JW. A concise introduction to mixed methods research. United States Am SAGE. 2014;

22. Puchalski Ritchie LM, Kip EC, Mundeva H, Van Lettow M, Makwakwa A, Straus SE, et al. Process evaluation of an implementation strategy to support uptake of a tuberculosis treatment adherence intervention to improve TB care and outcomes in Malawi. BMJ Open. 2021 Jul 1;11(7):e048499.

23. Carroll C, Patterson M, Wood S, Booth A, Rick J, Balain S. A conceptual framework for implementation fidelity. Implement Sci. 2007 Dec;2(1):1–9.

24. Pérez D, Van der Stuyft P, Del M, Zabala C, Castro M, Lefèvre P, et al. A modified theoretical framework to assess implementation fidelity of adaptive public health interventions. Implement Sci. 2016 Jul;11(1):91.

25. Ghana Health Service. IMPLEMENTATION PLAN FOR ISONIAZID PREVENTIVE THERAPY IN GHANA. 2017.

26. Ghana Health Service. Implementation of TB / HIV collaborative activities in Ghana: Technical policy and guidelines. 2007.

27. Spiliotopoulou G. Reliability reconsidered: Cronbach's alpha and paediatric assessment in occupational therapy. Aust Occup Ther J. 2009 Jun 1;56(3):150–5.

28. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ. 2011 Jun 27;2:53–5.

29. Huijg JM, Gebhardt WA, Dusseldorp E, Verheijden MW, van der Zouwe N, Middelkoop BJC, et al. Measuring determinants of implementation behavior: Psychometric properties of a questionnaire based on the theoretical domains framework. Implement Sci. 2014 Mar 19;9(1):33.

30. Durlak JA, DuPre EP. Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. Am J Community Psychol. 2008 Jun;41(3–4):327–50.

31. Mihalic S. THE IMPORTANCE OF IMPLEMENTATION FIDELITY. 2002.

32. Bellg AJ, Resnick B, Minicucci DS, Ogedegbe G, Ernst D, Borrelli B, et al. Enhancing treatment fidelity in health behavior change studies: Best practices and recommendations from the NIH Behavior Change Consortium. Vol. 23, Health Psychology. 2004. p. 443–51.

33. Abry T, Hulleman CS, Rimm-Kaufman SE. Using Indices of Fidelity to Intervention Core Components to Identify Program Active Ingredients. Am J Eval. 2015 Sep 6;36(3):320–38.

34. Cofie P, De Allegri M, Kouyaté B, Sauerborn R. Effects of information, education, and communication campaign on a community-based health insurance scheme in Burkina Faso. Glob Health Action. 2013;6:20791.

Appendix E Ethics clearance certificates

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

14 November 2018
Person No: 1743525
PAG

Mr SA Narh-Bana
P. O. Box Dd1
Dodowa Health Research Centre
Ghana Health Service
0000
Ghana

Dear Mr Solomon Narh-Bana

Doctor of Philosophy: Approval of Title

We have pleasure in advising that your proposal entitled *Assessing the implementation fidelity and determinants: A case of active TB case-finding and IPT initiation among PLHIV attending HIV clinics in Ghana* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

UNIVERSITY OF THE
WITWATERSRAND
JOHANNESBURG

R14/49 Mr Solomon Ayertey Narh-Bana

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M190110

NAME: (Principal Investigator)	Mr Solomon Ayertey Narh-Bana
DEPARTMENT:	School of Public of Health Epidemiology and Biostatistics 10 regional health administrations 27 districts health directorates 27 health facilities
PROJECT TITLE:	Assessing the implementation fidelity and determinants: A case of active TB case-finding and IPT initiation among PLHIV attending HIV clinics in Ghana.
DATE CONSIDERED:	25/01/2019
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof Tobias Chirwa, Dr Mary Kawonga and Dr Frank Bonsu
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	11/03/2019

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in January and will therefore be due in the month of January each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: +233-302-681109
Fax + 233-302-685424
Email: ghserc@gmail.com
14th February, 2019

MyRef. GHS/RDD/ERC/Admin/App 19/044
Your Ref. No.

Solomon Ayertey Narh-Bana
Dodowa Health Research Center
P.O. Box DDI
Dodowa. Ghana

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC002/01/19**
Project Title	Assessing the Fidelity and Determinants of Implementation: A Case of Active TB Case-Finding and IPT Initiation among PLHIV Attending HIV Clinics in Ghana.
Approval Date	14th February, 2019
Expiry Date	13th February, 2020
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.
- Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
PROFESSOR MOSES AIKINS
(GHS-ERC VICES CHAIRPERSON)

Appendix F: Permission letters

In case of the reply the number
and the date of this letter
should be quoted.

My Ref. No...NTP/01/19

Your Ref. No.....

GHANA HEALTH SERVICE
PRIVATE MAIL BAG
ACCRA. GHANA.

02 April, 2019

Regional Directors of Health Services
Ghana Health Service

Dear Sir/Madam

Solomon A. Narh-Bana (PhD Candidate)
"Assessing the fidelity and determinants of implementation: a case of active TB case-finding among PLHIV attending HIV clinics in Ghana"

Ghana is about to roll out TB Preventive Therapy (IPT). Implementation just started in selected facilities.

In collaboration with National TB Control programme Mr. Solomon Narh , from Dodowa Health Research Center is undertaking above named study to help inform programme implementation as he gathers information for his PhD doctorate.
He has approval from Ghana Health Service Ethics review committee.

The study will be conducted in **27 health facilities within 27 districts and in all ten regions across Ghana** from **March to December 2019.** It will involve conducting structured interviews, extraction of data, in-depth interviews and focus group discussions with HIV care providers, TB/HIV coordinators (regional, district and facility) and Heads of facilities in selected districts.
This serves to introduce Mr Narh and the research team and also seek your expressed permission to facilitate the study.

We count on your understanding and continuous support to end TB.

Dr Frank Bonsu
Public Health Consultant.
Head of National TB Programme

In case of the reply the number
And the date of this letter
Should be quoted.

My Ref. No: HP/1/VOL/1
Your Ref. No.....

GHANA HEALTH SERVICE
REGIONAL HEALTH DIRECTORATE
P. O. BOX 145
SUNYANI

E- Mail Address:
ghsbar@yahoo.com

Telephone: 03520- 24404/27120 /23400
Fax: 03520- 27079

~~1 January 2019~~
16th April 2019

INTRODUCTORY LETTER

SOLOMON A. NARH-BANA

I write to introduce to you Solomon A. Narh-Bana, a Ph.D. Candidate and a team of Researchers from Dodowa Health Research center and in partnership with the National Tuberculosis Control Programme, Accra.

As part of his academic requirement for the award of PhD degree, he is undertaking a study on the topic, **"Assessing the fidelity and determinants of implementation: a case of active TB case finding among PLHIV attending HIV clinics in Ghana."**

The study will be conducted in 27 health facilities within 27 districts and in all ten regions across Ghana from March to December 2019. It will involve in-depth interviews and focus group discussions with HIV Care providers, TB/HIV Coordinators and Heads of facilities in selected districts.

Kindly accord the Principal Investigator your usual courtesy and cooperation

Thank you

DR. AMO-KODIEH
AG. REGIONAL DIRECTOR OF HEALTH SERVICES
BRONG AHAFO

THE MUN/DISTRICT DIRECTOR OF HEALTH SERVICES

KINTAMPO NORTH MUNICIPAL
ATEBUBU-AMANTEN MUNICIPAL
JAMAN NORTH DISTRICT

GHANA HEALTH SERVICE

OUR CORE VALUES:
1. People-Centered
2. Professionalism
3. Team work
4. Innovation
5. Discipline
6. Integrity

My Ref No: GHS/NR/18-0/199

Your Ref No: .....

Regional Health Directorate
Ghana Health Service
P.O. BOX 99
Tamale

Wednesday, 10 April 2019

Tel: (233) (03720) 22912, 22710, 22146
Fax: (233) (03720) 22941
Email: rdhs.nr@ghsmail.org

PERMISSION TO COLLECT DATA FOR RESEARCH PURPOSE

I would be very grateful if Mr.Solomon A.Narh-Bana, from Dodowa Health Research Center, and a PhD candidate and Principal Investigator, in collaboration with the National Malaria Control Programme, leading a team of other research officers be granted permission to collect data from facilities in your district/metropolis to address the research topic:
"*Assessing the fidelity and determinants of implementation: a case of active TB case-finding among PLHIV attending HIV clinics in Ghana*".

The study will be conducted in 27 health facilities within 27 districts and in all ten regions across Ghana from March to December, 2019.
The study involves conducting structured interviews, extraction of data, in-depth interviews and focus group discussions with HIV care providers, TB/HIV coordinators (regional, district, and facility) and heads of facilities in the selected districts.

The research has been given approval from the GHS Ethics Review Committee – (GHS-ERC002/01/19.
The data so collected will be treated as confidential and it is only for research purpose.
Thank you.

Jeremiah M. Tiimob
Dep.Director – Administration
For: Reg.Director of Health Services

Distribution

- ✓ *The Medical Superintendent*
  Tamale Central Hospital
  Tamale Metropolis

- ✓ *The Medical Superintendent*
  Assemblies of God Hospital-Saboba
  Saboba District

OUR CORE VALUES

- People-Centered
- Professionalism
- Team work
- Innovation
- Discipline
- Integrity

Regional Health Directorate
Ghana Health Services
Private Mail Bag
Bolgatanga, UER
GHANA.

15th April, 2019
Tel: (03820) 22335
Fax: (03820) 24390
E-mail: ghs-uer@4u.com.gh

My Ref.
No:GHS/UER/ORD/RES/G-6

THE DISTRICT DIRECTORS
K.N.M, BOLGA MUNICIPAL
AND BUILSA NORTH
GHANA HEALTH SERVICE
UPPER EAST REGION

LETTER OF INTRODUCTORY

This is to introduce to you **Mr. Solomon A. Narh-Bana** from Dodowa Health Research Center who is to undertake his research at your facilities. This is to inform you that Mr. Solomon A. Narh-Bana has been granted approval.

His research topic is **"Assessing the fidelity and determinants of implementation: a case of active TB case finding among PLHIV attending HIV clinics in Ghana"**

It will involve conducting structured interviews, extraction of data, in- depth interviews and focus group discussions with HIV care providers, TB/HIV coordinators in the districts.

Please accord him the necessary assistance for the success of the exercise.

Thank you.

15/4/19

E. ADJEI-FRIMPONG
DEPUTY DIRECTOR (ADMINISTRATION)
FOR: REGIONAL DIRECTOR OF HEALTH SERVICES (UER)

In case of reply the number and the date of this letter should be quoted

My Ref No:

Your Ref. No

Eastern Reg. Health Directorate
GHANA HEALTH SERVICE
P. O. Box KF 175
Koforidua
GHANA

16th April 2019

Municipal Director of Health Services (Akwapim North)
Municipal Director of Health Services (Atiwa)
District Director of Health Services (Upper Manya-Krobo)
District Director of Health Services (Birim North)

RE: SOLOMON A. NARH-BANA (PhD CANDIDATE) – "ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE FINDING AMONG PLHIV ATTENDING HIV CLINICS IN GHANA"

The bearer of this letter is conducting a research on the topic above and your district is part of the selected districts in the nation-wide study as stated above.

Find attached the details. Please offer him all the necessary help as required to enable him conduct this studies successfully.

Thank you.

Michael Kyei-Mensah
Regional Accountant
For: Regional Director of Health Services.
Eastern Region.

Copy: Regional Research Coordinator

In case of the reply the number and the date of this letter should be quoted.

My Ref. No.GHS/WRHD/04/19
Your Ref. No. .....
Tel No. 031-204660,46305,46801
E-mail: rdhs.wr@ghsmail.org
FAX NO. 031-46462

GHANA HEALTH SERVICE
Your Health - Our Concern

REGIONAL HEALTH DIRECTORATE
GHANA HEALTH SERVICE
P. O. BOX 202
SEKONDI

15TH APRIL, 2019

RE: ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMTATIOM: A CASE OF ACTIVITY TB CASEFINDING AMONG PLHIV ATTENDING HIV CLINICS IN GHANA
SOLOMON A. NARH-BANA (PhD CANDIDATE0

I forward to the attached letter referenced GHS/RDD/ERC Admin/App19/044 dated 14th February, 2019 from the Ghana Health Service Ethics Review Committee Chairperson on the above subject matter.

The above-mentioned person has been granted approval by the Regional Director to conduct the above-named study in 27 Health Facilities within 27 Districts among which three (3) Districts in the Western Region happens to be part of the selected for the exercise.

You are by a copy of this letter requested to hold yourselves in readiness and accord Mr. Narh and his research team the necessary support and assistance to carry out this study for a successful program.

Counting on your usual co-operation.

Thank you

MR. THOMAS K. TAWIAH
DEPUTY DIRECTOR, ADMINISTRATION
FOR: **REGIONAL DIRECTOR OF HEALTH SERVICE**
WESTERN REGION

In case of the reply the number and the date of this letter should be quoted
My Ref. No : CR/CRHD/G 5/317
You Ref. No. .....
GHS CORE VALUES:

- INTERGRITY
- INNOVATIVE/EXCELLENCE
- TEAMWORK
- PEOPLE-CENTRED
- PROFESSIONALISM
- DISCIPLINE

GHANA HEALTH SERVICE
Your Health - Our Concern

REGIONAL HEALTH DIRECTORATE
P. O. BOX 63
CAPE COAST
CENTRAL REGION

8TH APRIL, 2019

RE: ASSESSING THE FIDELITY AND DETERMINANATS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASEFINDING AMONG PLHIV ATTENDING HIV CLINICS IN GHANA SOLOMON A. NARH-BANA (PhD CANDIDATE)

I forward to the attached letter referenced *GHS/RDD/ERC/Admin/App19/044* dated 14th February, 2019 from the Ghana Health Service Ethics Review Committee Chairperson on the above subject matter.

The above-mentioned person has been granted approval by the Regional Health Directorate to conduct the above-named study in 27 health facilities within 27 districts among which 3 districts in the Central Region happens to be part of the areas selected for the exercise.

You are by a copy of this letter requested to hold yourselves in readiness and accord Mr. Narh and his research team the necessary support and assistance to carry out this study for a successful program.

Counting on your maximum co-operation.

Thank you.

MR. EMMANUEL TAADI
DEPUTY DIRECTOR-ADMINISTRATION
FOR: REGIONAL DIRECTOR OF HEALTH SERVICE
CENTRAL REGION

DISTRIBUTION:

THE MUN/DISTRICT DIRECTORS OF HEALTH SERVICE

- **ABURA-ASEBU-KWAMANKESE**
- **AWUTU SENYA EAST**
- **TWIFO-ATI-MOKWA**

In case of reply the number
and the date of this letter
should be quoted

My Ref: GHS/ASH/INTRO
Your Ref. No:

Tel: 22089/23651
Fax:
E-mail: rdhs.ar@ghsmail.org

GHANA HEALTH SERVICE
REG HEALTH DIRECTORATE
P. O. BOX 1908
KUMASI

16TH JULY, 2018

THE METRO/MUN/DIST. DIR. OF H/SERVICE
GHANA HEALTH SERVICE
KUMASI, EJISU-JUABEN, ATWIMA NWABIAGYA
AND OBUASI MUNICIPAL

LETTER OF INTRODUCTION
SOLOMON A. NARH-BANA (PhD Candidate)

This is to introduce to you the research team of Mr. Solomon Narh-Bana (PhD Candidate).

He has been permitted to conduct a research titled "**Assessing the Fidelity and Determinants of Implementation: A Case of Active TB Case-Finding Among PLWHIV Attending HIV Clinics in Ghana**".

Please find attached details from the Head of National TB Programme, Ghana Health Service, Accra.

We would be very grateful if the research team is given the necessary assistance to carry out the research.

Thank you.

DR. EMMANUEL K. TINKORANG
REG. DIR. OF HEALTH SERVICE
ASHANTI

8/4/19

In case of reply the number and date of this letter should be quoted.

My Ref. No. GHS/GAKHD/007/19

Your Ref. No.

GHANA HEALTH SERVICE
REGIONAL HEALTH DIRECTORATE
GREATER ACCRA
P. O. BOX 184
ACCRA

Tel: +233-0302-234225/226203

E-mail:c_brako@yahoo.com

8th April, 2019

Ga West Mun. Health Directorate
RECEIVED
09 APR 2019
P.O. Box AM 139, Amasaman

THE MEDICAL DIRECTOR
GREATER ACCRA REGIONAL HOSPITAL, RIDGE
ACCRA

THE MUNICIPAL DIRECTOR OF HEALTH SERVICES
GA WEST MUNICIPAL HEALTH DIRECTORATE
AMASAMAN

RE: SOLOMON A. NARH-BANA (PhD CANDIDATE)
"ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AMONG PLHIV ATTENDING HIV CLINICS IN GHANA"

This is to introduce to you **Solomon A. Narh-Bana** from the Dodowa Health Research Center who has approval from the Regional Health Directorate to undertake a study on the topic: ***"Assessing the Fidelity and Determinants of Implementation: A Case of Active TB Case-Finding among PLHIV attending HIV clinics in Ghana"*** as per attached.

You are kindly entreated to provide the needed assistance.

Thank you.

DR. (MRS.) CHARITY SARPONG
REGIONAL DIRECTOR OF HEALTH SERVICES
GREATER ACCRA

Send to Awura
16/4/19

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

11 April 2022
Person No: 1743525
TAA

Mr SA Narh-Bana
P. O. Box Dd1
Dodowa Health Research Centre
Ghana Health Service
0000
Ghana

Dear Mr Solomon Narh-Bana

Doctor of Philosophy: Change of title of research

I am pleased to inform you that the following change in the title of your Thesis for the degree of Doctor of Philosophy has been approved:

From:	**Assessing the implementation fidelity and determinants: A case of active TB case-finding and IPT initiation among PLHIV attending HIV clinics in Ghana**
To:	**Assessing the fidelity and determinants of implementation: A case of active TB case-finding and IPT initiation among PLHIV attending HIV clinics in Ghana**

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Appendix G: Data collection tool for assessing provider-level implementation fidelity

UNIVERSITY OF THE WITWATERSRAND

FACULTY OF HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH

Study title: **ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA**

Provider Questionnaire: Interview with HIV care providers (to assess fidelity, participant responsiveness, and perceptions of intervention complexity)

INFORMATION PANEL	
Region Code: _____ District Code: _____ Facility Code:_____	
Name of Interviewer _____	**Date of interview**: _mm__/__dd_ / _yy__

My name is ..... and I am student of University of the Witwatersrand in Johannesburg, South Africa. I want to ask you some questions about your work in this clinic. The purpose of this interview is to gather information that will help us to identify areas of the services that need improvement to reach all who needed the service in Ghana.

Seek consent **Time interview started:_____**

No	Questions	Response
Section A: Socio-Demographic Information – provider characteristics		
1.	Age (in completed years)	
2.	Sex	Male……..…….....1 Female…….….....2
3.	Number of years working in this HIV care clinic (in completed years)	
4.	Occupation category/Cadre of health worker	Doctor …..…….....1 Medical Assistant……..…….....2 Professional Nurse…. ..…….…….....3 Auxiliary nurse ……4
5.	Level of education (highest level completed)	Postgraduate degree or diploma ……1 Bachelor Degree……..2 Undergraduate Diploma……..3 Secondary ……...5 Junior Secondary ……1
	Section B: Provider Adherence – Content and frequency	
	TB screening	
	I would like to know about the care you provide for TB screening of HIV care clients	
	Content	**Frequency**

	Please tell me about the screening activities you perform for the patients. ***Probe***s: You may only ask "anything else"? ***Interviewer:*** a) If participant mentions an activity listed below, code "1" as instructed below and ask about frequency (in next column) b) c) If participant does not mention an activity, code "0" and write "88" in the frequency column		***Interviewer:*** For each activity s/he mentions, ask the participant: When do you do this activity for PLHIV?
	List of activities	**Code:** 0 if not mentioned 1. If mentioned	**Code:** Rarely For some clients sometimes Either for all new clients or annually for existing clients For new clients AND annually for existing clients 88. Not applicable
6.	Provides education		
7.	Provides counselling about TB screening		
8.	Uses TB screening questionnaire (clinical algorithm)		
9.	Asks client about cough of any duration		
10	Asks if the client has pain in the chest		
11	Asks if the client has night sweats		
12	Asks/checks if the client lost weight		
13	Asks if the client had fever		
	Interviewer: please ask participant How do you decide which clients to ask which screening questions	***Write their responses here***	
	TB testing and IPT initiation		
14	After screening the client for TB, what do you do next?	***Interviewer:*** *write responses here, will be coded later*	
15	If you ever identify a client who you suspected has TB, what steps do you take?	***Interviewer:*** *write responses here, will be coded later*	
16	What do you do if a client does not present any sign or symptom for TB when you have screened them?	***Interviewer:*** *write responses here, will be coded later*	
	Section C: Moderating factors		
	C1: Quality of delivery		
17	I am going to read out a number of statements. For each statement I will ask you whether you strongly agree, agree, feel neutral, disagree or strongly disagree.		
18	I feel I am competent in giving health education on TB to PLHI	1. Strongly disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly agree	

19	I feel I am competent in counselling PLHIV about TB screening	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
20	I feel I am competent in using the screening questionnaire to screen PLHIV for TB	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
21	I feel I am competent in determining whether or not a client is a TB suspect after using the screening questionnaire	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
22	I feel competent to decide whether a client should be started on IPT	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
23	I am confident in my ability to decide when a client needs to be referred for TB testing	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
24	I feel I am competent in initiating clients on IPT	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
	C2: Participant responsiveness					
25	I am motivated to apply the questionnaire for TB screening on PLHIV	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
26	TB screening of PLHIV is a useful intervention	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
27	I have received adequate training to provide TB screening	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
28	IPT initiation in PLHIV is a relevant intervention in this setting	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
29	I am motivated to initiate IPT in PLHIV	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
30	TB screening of PLHIV is a useful intervention	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
31	I feel I have received adequate training to initiate IPT	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
32	The TB screening questionnaire is a useful tool or screening PLHIV for TB	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
33	TB screening in PLHIV won't make a difference to the HIV epidemic	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
34	I have adequate support from my colleagues to do TB screening	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
35	I have adequate support from the HIV coordinator to do TB screening	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
36	I have adequate support from my in charge to do TB screening	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree

Appendix H: Data collection tool for assessing facility-level implementation fidelity

UNIVERSITY OF THE WITWATERSRAND

FACULTY OF HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH

Study title: **ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA**

Interview with heads of facility and HIV clinic and facility TB/HIV co-ordinator

INFORMATION PANEL	
Region Code: _____ District Code: _____ Facility Code:_____	
Name of Interviewer _____	**Date of interview**: _mm__/__dd_ / _yy__

My name is ..... and I am student of University of the Witwatersrand in Johannesburg, South Africa. I want to ask you some questions about your the HIV clinic. The purpose of this interview is to gather information that will help us to identify areas of the services that need improvement to reach all who needed the service in Ghana.

Seek consent **Time interview started: _____**

No	Questions	Response
Section A: Socio-Demographic Information		
1	Respondent	Head of HIV clinic...…….....1 TB/HIV co-ordinator…….....2
2	Age (in completed years)	
3	Sex	Male……...…….....1 Female…….....2
4	Number of years working in this HIV care clinic (in completed years)	
5	Occupation category/Cadre of health worker	Doctor …..…….....1 Medical Assistant…….…….....2 Professional Nurse…. ..…….…….....3 Auxiliary nurse ……4
6	Number of years in your current capacity / role?	
7	Level of education (highest level completed)	Postgraduate degree or diploma ……1 Bachelor Degree……..2 Undergraduate Diploma……...3 Secondary ……...5 Junior Secondary ……1

	Section B: General information about the HIV clinic			
7	What are the different units/clinics providing services to clients in this facility?			
	Section C: Adherence to policy guidelines on delivery of TB screening and IPT interventions (content and frequency)			
	Do you provide any of the following TB/HIV services this HIV care clinic?	**Content** ***Code:*** 0 No 1. Yes	**Frequency** **If yes, how frequently** ***Code:*** 1. One day a week 2. A few days a week (1-4) 3. Every day of the week (5 day) 4.Other (specify): 88. Not applicable	
8	TB screening for PLHIV			
9	Sputum testing for PLHIV (any method)			
10	Chest x-ray for TB testing			
11	How do you ensure TB infection control in your clinic?			
12	Does this HIV care clinic provide IPT for PLHIV?	No……..…0 Yes……1		
	If yes: To which group/s of clients do you provide IPT?			
13	Only Children	No……..…0 Yes……1	How long has this clinic been providing IPT for this group?	
14	Only Pregnant women	No……..…0 Yes……1	How long has this clinic been providing IPT for this group?	
15	Only specialized cases recommended by clinician	No……..…0 Yes……1	How long has this clinic been providing IPT for this group?	
16	All PLHIV	No……..…0 Yes……1	How long has this clinic been providing IPT for this group?	
17	Does this facility conducts meetings on TB case finding or TB screening of PLHIV	Never ……0 Annually……. 1 Quarterly ……2 Monthly ……..3 Other (specify)……. 4 …….		
18	Does the meeting on the TB case finding programme include the HIV care providers	Never……0 Rarely ……..1 Often……2 Always ……3		
19	What is the purpose of these meetings and what is discussed there? Open-ended, please let the participant explain and then code on the right	Providing feedback to providers on their practice……..…1 Sharing of data…….....2 Discuss TB/HIV training……..3 Other (specify)……4 ……		
20	**Adherence: continuum of care**		**Moderating factors: Facilitation strategies**	

	Please tell me which activities each provider has been allocated to perform in the last three months. ***Interviewer:*** Open-ended, let the participant respond and code "0" if not mentioned and "1 if it is mentioned"						Tell me about the training this provider has received, if any ***Interviewer:*** Open-ended, let the participant respond and code "0" if not mentioned and "1 if it is mentioned"			
	HIV care provider initials	**Health education of PLHIV?**	**Counselling of PLHIV**	**TB screening?**	**Referral for TB testing**	**IPT initiation**	**Health education**	**Counselling**	**Use of screening tool**	**IPT initiation**
	1									
	2									
	4									
	5									
	6									
	7									
	8									
	9									
	10									
	11									
	12									
	13									

	C. Moderating factors – facilitation strategies		
	On which days of the week is this facility open?		
21	How do you handle infection control in this HIV care clinic? Open question (multiple responses allow)	***Tick if mentioned:*** Infection control plan……...1 Infection guidelines made available to staff……..2 Infection control training for staff……..…..3	
22	How many health workers have had infection control training in this HIV care clinic?		
23	How often does your facility assess for TB infection among health care workers?	Never…….……0 Annually …….……1 Quarterly…….2 Monthly ……..3 Other (specify)……4	
24	What do you think is the level of awareness of TB screening amongst workers in the other units (other than HIV care clinic) within this facility?	Poor…….0 Fair……..1 Good……2 Very good ……..3 Excellent……..4	
25	Are the other units within the facility aware of IPT for all HIV clients who are TB screened negative.	No……..…0 Yes……1	
26	Please may you describe how this facility monitors HIV providers in their provision of TB screening and IPT?		
	Moderating factors – facilitation strategies (collect data by observation) *Note: Fill for one person per facility*		

	Do you have any of the following tools / resources available in this facility?	***Available*** No……..…0 Yes……1	Available for provider No……..…0 Yes……1 ***NB: verify the availability of these on the facility checklist***	
27	TB screening questionnaire / algorithm			
28	TB/HIV clinical manual			
29	Guidelines for TB screening			
30	Guidelines for IPT provision			
31	IEC materials for use by the providers\			
32	Infection control guidelines			
33	Does your facility have lab facilities for sputum testing?			

Appendix I: Data extraction form

UNIVERSITY OF THE WITWATERSRAND

FACULTY OF HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH

Study title: **ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA**

Extract data from TB register/monthly returns form

INFORMATION PANEL	
Region Code: _____ District Code: _____ Facility Code:_____	
Name of Interviewer _____	**Date of interview**: _mm__/__dd_ / _yy__

Monthly data for 1 year

Month	Type of Consultation	# On ART	# Screened for TB	# Screened Negative	# Initiate IPT	# Further test		
						X-ray	GeneXpert	MTB/RIF
1	New							
	Follow up							
2	New							
	Follow up							
3	New							
	Follow up							
4	New							
	Follow up							
5	New							
	Follow up							
6	New							
	Follow up							
7	New							
	Follow up							
8	New							
	Follow up							
9	New							
	Follow up							
10	New							
	Follow up							
11	New							

	Follow up							
12	New							
	Follow up							

Appendix J: In-Depth Interview guide for exploring implementation determinants

UNIVERSITY OF THE WITWATERSRAND

FACULTY OF HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH

Study title: **ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA**

For IDI with facility, district and regional TB/HIV coordinators

A. Background information

- Respondent ID (participant code):
- Respondent type:
- Indicate Gender:
- How old are you?
- What is your educational level?
- What is your occupation / position?
- How long have you been working in this unit/facility/capacity?
- Please kindly tell me about your main roles and responsibilities

B. Intervention Characteristics

a. Evidence Strength and Quality

1. What kind of information or evidence are you aware of that shows whether or not the TB screening among PLHIV is working in your facility?
    - What are the sources of your information or evidence?
2. In a healthcare setting, some stakeholders may include whether and how interventions get implemented. Who do you think are the influential stakeholders when it comes to implementation of the TB/HIB collaborative activities - particularly TB screening and IPT in PLHIV?
    - **Probes:** Stakeholders in this facility?
      Stakeholders outside this facility?
      In what ways do these stakeholders influence implementation?

b. Relative Advantage

3. How does the intervention for TB screening and IPT among PLHIV compare to other similar existing programs in your setting?
    - Any advantages compared to other existing programs?
    - Any disadvantages compared to other existing programs?

c. Complexity

4. Would you say the intervention for TB screening of PLHIV is complicated or not complicated? Please kindly explain your response – in what ways would you say it is complicated / not?
    - **Probe**: what about in terms of: the duration, scope, intricacy, number of steps involved
      does the intervention reflects a clear departure from previous practices?

5. What do you think about the intervention of giving IPT for PLHIV? Would you say it is complicated or not complicated? Please explain– in what ways it is complicated / not?
    - **Probe**: what about in terms of: the duration, scope, intricacy, number of steps involved
      does the intervention reflects a clear departure from previous practices?

d. Cost

6. What costs are incurred by this facility / district / region that you know in the implementation of the TB screening and IPT intervention among PLHIV?

C. Outer setting

a. Cosmopolitanism

7. Tell me about whether and how providers in this HIV care clinic relate with or network with their colleagues outside your facility who are also implementing TB screening and IPT intervention among PLHIV?
    - Probes: Any information exchange? What kind of information? How?
      Able to attend conferences and trainings?
      To what extent facility encourages providers to network with colleagues outside?

D. Inner setting

a. Structural characteristics

8. Please tell me about infrastructure in your facility?
    - ***Probe***: Social architecture, age, maturity, size, or physical layout.
      How infrastructure may hinder or facilitate implementation of the TB screening among PLHIV?

9. Please tell me about any structural changes your organisation made towards sustaining the TB screening among PLHIV?
    - ***Probe for*** changes in scope of practice? Changes in formal policies? Changes in information systems or electronic records systems? Other structural changes?
    - How did you work around these changes?

b. Networks & Communications

10. Can you describe working relationships amongst colleagues in this facility?
    - Between colleagues in the HIV care unit/clinic?
    - Between colleagues in the HIV care unit and other units?
    - Are meetings, such as staff meetings, held regularly in this HIV care unit?
    - Who typically attends?
    - What proportion of staff typically attend?
    - How often are the meetings held?
    - What is a typical agenda? How helpful are these meetings towards implementation?
11. How do you typically find out about new information, such as new initiatives, accomplishments, issues, new staff, staff departures?
12. When you need to get something done or to solve a problem, who are your "go-to" people?

E. Implementation Climate

a. Tension for Change

13. Do you see a strong need for this TB screening among PLHIV intervention?
    - Why or why not?
    - Do others see a need for the intervention?
    - How important is this intervention to meet the needs of the individuals served by facility / district / region?
    - How do people within your facility / district health level / regional health level feel about current programs/practices/process that are related to the intervention?

b. Relative Priority

14. What kinds of high-priority activities are happening in your facility / district / region?
    - How, if at all, is this intervention on TB screening in PLHIV conflicting with these priority activities?

c. Organizational Incentives & Rewards

15. What kinds of incentives are there to help ensure that the implementation of the intervention is successful?
    - What is your motivation for wanting to help ensure the implementation is successful?

d. Goals & Feedback

16. Have you/your unit/your organization set goals related to the implementation of the intervention?
    [If yes] What are the goals? To what extent are organizational goals monitored for progress?

- Can you give an example of monitoring in terms of the type of information, who is informed, and how?
- Do you get any feedback reports about your work?
- What do they look like? Content, mode, form?
- How helpful are those reports? How can they be improved?
- How often do you get them? Where do they come from?

Any general comment?

Thank you for the information and your time!!

Appendix K: Focus Group Discussion guide for exploring implementation determinants

UNIVERSITY OF THE WITWATERSRAND

FACULTY OF HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH

Study title: **ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA**

For FGD with HIV care providers

A. Background information *(Please use the FGD recruitment form to capture section A)*

1. Respondent ID (participant code):
2. Respondent type:
3. Indicate Gender:
4. How old are you?
5. What is your educational level?
6. What is your occupation / position?
7. How long have you been working in this unit/facility/capacity?
8. Please kindly tell me about your main roles and responsibilities

Instruction for the moderator: Set rules for the discussion and encourage participants to speak louder

1. What do you do in your clinic?
2. What do you know about the TB screening among PLWHIV intervention
3. How confident do you as HIV care providers feel about performing screening for TB among PLHIV? Why confident, why not?
4. What gives you that level of confidence (or lack of confidence)?

B. Intervention Characteristics

a. Evidence Strength and Quality

5. What kind of information or evidence are you aware of that shows whether or not the TB screening and IPT initiation among PLHIV is working in your facility?

    a. What are the sources of your information or evidence?

2. In a healthcare setting, some stakeholders may include whether and how interventions get implemented. Who do you think are the influential stakeholders when it comes to implementation of the TB/HIB collaborative activities - particularly TB screening and IPT in PLHIV?

    a. **Probes:** Stakeholders in this facility?
    Stakeholders outside this facility?
    In what ways do these stakeholders influence implementation?

b. Relative Advantage

3. How does the intervention for TB screening and IPT among PLHIV compare to other similar existing programs in your setting?
    a. Any advantages compared to other existing programs?
    b. Any disadvantages compared to other existing programs?

c. Complexity

4. Would you say the TB screening, is complicated or not complicated? Please kindly explain your response – in what ways would you say it is complicated / not?
    a. **Probe**: what about in terms of: the duration, scope, intricacy, number of steps involved does the intervention reflects a clear departure from previous practices?

5. What do you think about the intervention of giving IPT for PLHIV? Would you say it is complicated or not complicated? Please explain– in what ways it is complicated / not?
    a. **Probe**: what about in terms of: the duration, scope, intricacy, number of steps involved does the intervention reflects a clear departure from previous practices?

d. Cost

6. What costs are incurred by this facility / district / region that you know in the implementation of the TB screening and IPT intervention among PLHIV?

e. Beliefs about the intervention

7. What are your thoughts about sustainability of the intervention in your setting?
    - How, if at all, could it be sustained in your setting?
    - Why or why would it not be sustained?

C. Outer setting

a. Cosmopolitanism

8. Tell me about whether and how providers in this HIV care clinic relate with or network with their colleagues outside your facility who are also implementing TB screening and IPT intervention among PLHIV?
    - Probes: Any information exchange? What kind of information? How?
      Able to attend conferences and trainings?
      To what extent facility encourages providers to network with colleagues outside?

D. Inner setting

a. Structural characteristics

9. Please tell me about infrastructure in your facility?
    a. ***Probe***: Social architecture, age, maturity, size, or physical layout.

How infrastructure may hinder or facilitate implementation of the TB screening among PLHIV?

10. Please tell me about any structural changes your organisation made towards sustaining the TB screening among PLHIV?
    a. ***Probe for*** changes in scope of practice? Changes in formal policies? Changes in information systems or electronic records systems? Other structural changes?
    b. How did you work around these changes?

b. Networks & Communications

11. Can you describe working relationships amongst colleagues in this facility?
    a. Between colleagues in the HIV care unit/clinic?
    b. Between colleagues in the HIV care unit and other units?
    c. Are meetings, such as staff meetings, held regularly in this HIV care unit?
    d. Who typically attends?
    e. What proportion of staff typically attend?
    f. How often are the meetings held?
    g. What is a typical agenda? How helpful are these meetings towards implementation?
12. How do you typically find out about new information, such as new initiatives, accomplishments, issues, new staff, staff departures?
13. When you need to get something done or to solve a problem, who are your "go-to" people?

E. Implementation Climate

a. Tension for Change

14. Do you see a strong need for this TB screening among PLHIV intervention?
    a. Why or why not?
    b. Do others see a need for the intervention?
    c. How important is this intervention to meet the needs of the individuals served by facility / district / region?
    d. How do people within your facility / district health level / regional health level feel about current programs/practices/process that are related to the intervention?

b. Relative Priority

15. What kinds of high-priority activities are happening in your facility / district / region?
    a. How, if at all, is this intervention on TB screening in PLHIV conflicting with these priority activities?

c. Organizational Incentives & Rewards

16. What kinds of incentives are there to help ensure that the implementation of the intervention is successful?

a. What is your motivation for wanting to help ensure the implementation is successful?

d. Goals & Feedback

17. Have you/your unit/your organization set goals related to the implementation of the intervention?
    [If yes] What are the goals? To what extent are organizational goals monitored for progress?
    a. Can you give an example of monitoring in terms of the type of information, who is informed, and how?
    b. Do you get any feedback reports about your work?
    c. What do they look like? Content, mode, form?
    d. How helpful are those reports? How can they be improved?
    e. How often do you get them? Where do they come from?

Any general comment?

Thank you for the information and your time!!

Appendix L: Information sheet and consent forms

UNIVERSITY OF THE WITWATERSRAND, SCHOOL OF PUBLIC HEALTH

Study title: ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA

Informed consent form for: Facility heads, HIV clinic head, TB/HIV coordinator and HIV care providers

Name of principal investigator: Mr. Solomon A. Narh-Bana
Name of institution: University of the Witwatersrand

Information Sheet

My name is **……** and I am a Public Health (Implementation Science) student from the Wits University in South Africa. I would like to invite you to participate in a study that am undertaking as part of my studies.

Purpose of the study

The Ghana Health Service implemented different interventions to reduce the burden of TB among PLHIV attending HIV clinic. We are here today to discuss how you do your work and explore the factors that influence the implementation of the intervention in your facility. This will help inform the national office where support and improvement in the implementation are needed to achieving and sustaining the desired outcomes of the intervention in Ghana.

You have been selected because you are either the head of the facility, head of HIV clinic, TB/HIV coordinator or HIV care provider. Therefore your experience and opinions are very important in this endeavour.

Procedure

If you agree to be part of this study, we will interview you concerning TB and HIV care in your facility. Responses from you and selected staff will represent the views of other colleagues. The information we collect will be for the purposes of this work only and whatever we find out will be useful for taking very important decision for TB and HIV control in Ghana.

Voluntariness/Withdrawal

Your participation in the study is completely voluntary. You may refuse to answer any question or withdraw from the interview at any time and for any reason without it affecting you in any way. All your responses will be documented on the questionnaire and analysed later.

Risks and discomforts of the study

There is no risk to you for your participation. Although the discussion will take about 45 minutes.

Benefits of the study

As a participant and an individual, you may not benefit directly, but your participation and contribution will help us identify and address the implementation issues of the intervention aiming at reducing the burden of TB among PLHIV attending HIV clinics in Ghana. This will help all of us as a society in general.

Compensation

You will not be paid for participating in this study.

Confidentiality

Any information collected as a result of your participation and contribution will be treated as confidential and only used by the investigator by aggregating all other discussions. The questionnaire will not have your name on it and as such will be kept anonymous.

Questions

If you have any questions afterwards about this research or with regards to your rights as a participant in the study, you can contact the Administrator of **the Ghana Health Service Ethics Review Committee**, Ms. Hannah Frimpong on 0302681109 or contact the University Human Research Ethics Committee (Medical), Mr Rhulani Mkansi Rhulani.Mkansi@wits.ac.za or Ms Zanele Ndlovu zanele.ndlovu@wits.ac.za Tel: +27(0)11 717 1252/2700/1234/2656

If you have any questions concerning the study you can also contact the study principal investigator: Mr. Solomon Narh-Bana on 0244669893 or +27634795929

UNIVERSITY OF THE WITWATERSRAND, SCHOOL OF PUBLIC HEALTH

Study title: ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA

Consent form for: Facility heads, HIV clinic head, TB/HIV coordinator and HIV care providers

Consent Form

I have been adequately informed of (or I have read and understood) the purpose, procedures, potential risk and benefits of this study. I have had the opportunity to ask questions about it. Any questions that I have asked, have been answered to my satisfaction. I know that I can refuse to participate in this study without any loss of benefit to which I would have otherwise been entitled. I understand that if I agree to participate, I can withdraw my consent at any time without losing any benefits or services to which I am entitled. I understand that any information collected will be treated confidentially. I freely agree to participate in the study. After signing this document below, I will receive a copy each of the information sheet and this consent form.

Name of participant: …….

Signature: ……..

Date (dd/mmm/yyyy): ----------/----------/----------

Investigating team Member

I have adequately informed the participant of the purpose, procedures, potential risks and benefits of this study. I have answered all questions to the best of my ability.

Name of field staff (code): ……..

Signature: ……

Date (dd/mmm/yyyy): ----------/----------/----------

UNIVERSITY OF THE WITWATERSRAND, SCHOOL OF PUBLIC HEALTH

Study title: ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA

Informed consent form for: TB/HIV coordinators

Name of principal investigator: Mr. Solomon A. Narh-Bana
Name of institution: University of the Witwatersrand

Information Sheet

My name is **……** and I am a Public Health (Implementation Science) student from the Wits University in South Africa. I would like to invite you to participate in a study that am undertaking as part of my studies.

Purpose of the research

The Ghana Health Service implemented different interventions to reduce the burden of TB among PLHIV attending HIV clinics. We are here today to discuss and find out some of the factors influencing the implementation in your facility. This will help inform the national office where support and improvement in the implementation are needed to achieving and sustaining the desired outcomes of the intervention in Ghana.

You have been selected because you are a TB/HIV coordinator and therefore your experience and opinions are very important in this endeavour.

Procedure

If you agree to be part of this study, we will have discussion with you concerning TB/HIV clinics and care under your coordination. The information we collect will be for the purposes of this work only and whatever we find out will be useful for taking very important decision for TB/HIV control in Ghana. To make the discussion smooth running and time conscious, it will be audio recorded to enable us to remember the useful contributions you made.

Voluntariness/withdrawal

Your participation in the discussion is completely voluntary. You may refuse to answer any question or withdraw from the discussion at any time or for any reason refuse to the audio recording without it affecting you in any way.

Risks and discomforts of the study

There is no known risk with your participation but the discussion will take about 1hour.

Benefits of the study

As a participant and an individual, you may not benefit directly, but your participation and contribution will help us identify and improve the implementation of the intervention aiming at controlling TB and HIV in Ghana. This will help all of us as a society in general.

Compensation

You will not be paid for participating in this study.

Confidentiality

Any information collected as a result of your participation and contribution will be treated as confidential and only be used by the investigator by aggregating all other discussions. Whatever is recorded from the discussion can be played back to you after the discussion upon your request.

Questions

If you have any questions afterwards about this research or with regards to your rights as a participant in the study, you can contact the Administrator of **the Ghana Health Service Ethics Review Committee**, Ms. Hannah Frimpong on 0302681109 or contact the University Human Research Ethics Committee (Medical), Mr Rhulani Mkansi Rhulani.Mkansi@wits.ac.za or Ms Zanele Ndlovu zanele.ndlovu@wits.ac.za Tel: +27(0)11 717 1252/2700/1234/2656

If you have any questions concerning the study you can also contact the study principal investigator: Mr. Solomon Narh-Bana on 0244669893 or +27634795929

UNIVERSITY OF THE WITWATERSRAND, SCHOOL OF PUBLIC HEALTH

Study title: ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA

Consent form for: TB/HIV coordinators

Consent Form

I have been adequately informed of (or I have read and understood) the purpose, procedures, potential risk and benefits of this study. I have had the opportunity to ask questions about it. Any questions that I have asked, have been answered to my satisfaction. I know that I can refuse to participate in this study without any loss of benefit to which I would have otherwise been entitled. I understand that if I agree to participate, I can withdraw my consent at any time without losing any benefits or services to which I am entitled. I understand that any information collected will be treated confidentially. I freely agree to participate in the study and also record the discussion. After signing this document below, I will receive a copy each of the information sheet and this consent form.

Name of participant: …….

Signature: ……..

Date (dd/mm/yyyy): ----------/----------/----------

Investigating team Member

I have adequately informed the participant of the purpose, procedures, potential risks and benefits of this study. I have answered all questions to the best of my ability.

Name of field staff (code): ……..

Signature: ……

Date (dd/mmm/yyyy): ----------/----------/----------

UNIVERSITY OF THE WITWATERSRAND, SCHOOL OF PUBLIC HEALTH

Study title: ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA

Information Sheet

My name is **……** and I am a Public Health (Implementation Science) student from the Wits University in South Africa. I would like to invite you to participate in a study that am undertaking as part of my studies.

Purpose of the study

The Ghana Health Service implemented different interventions to reduce the burden of TB among PLHIV attending HIV clinics. We are here today to discuss and find out some of the factors influencing the implementation in your facility. This will help inform the national office where support and improvement in the implementation are needed to achieving and sustaining the desired outcomes of the intervention in Ghana.

You have been selected because you are an HIV care provider and therefore your experience and opinions are very important in this endeavour.

Procedure

As part of this project I would like to invite you to take part in a focus group discussion. If you agree to be part of this study, we will have discussion with you and your other colleagues together concerning TB and HIV care in your facility. The information we collect will be for the purposes of this work only and whatever we find out will be useful for taking very important decision for TB and HIV control in Ghana. To make the discussion smooth running and time conscious, it will be audio recorded to enable us to remember the useful contributions you made. With your permission, I would like to record the discussion using a digital device.

Voluntariness/withdrawal

Your participation in the discussion is completely voluntary. You may refuse to answer any question or withdraw from the discussion at any time or for any reason refuse to the audio recording without it affecting you in any way.

Risks and discomforts of the study

There is no known risk with your participation but the discussion will take about 1hr30mins.

Benefits of the study

As a participant of an FGD, you may not benefit directly, but your participation and contribution will help us identify and improve the implementation of the intervention aiming at controlling TB and HIV in Ghana.

Compensation

You will not be paid for participating in this study, but we will give you light refreshment after the discussion for long sitting and talking.

Confidentiality

I will be using a pseudonym (false name) to represent your participation in my final research report. If you experience any distress or discomfort, we will stop the interview or resume another time. Any information collected as a result of your participation and contribution will be treated as confidential and only be used by the investigator by aggregating all other discussions. Whatever is recorded from the discussion can be played back to you after the discussion upon your request.

Questions

If you have any questions afterwards about this research or with regards to your rights as a participant in the study, you can contact the Administrator of **the Ghana Health Service Ethics Review Committee**, Ms. Hannah Frimpong on 0302681109 or contact the University Human Research Ethics Committee (Medical), Mr Rhulani Mkansi Rhulani.Mkansi@wits.ac.za or Ms Zanele Ndlovu zanele.ndlovu@wits.ac.za Tel: +27(0)11 717 1252/2700/1234/2656

If you have any questions concerning the study you can also contact the study principal investigator: Mr. Solomon Narh-Bana on 0244669893

UNIVERSITY OF THE WITWATERSRAND, SCHOOL OF PUBLIC HEALTH

Study title: ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA

Consent form for: FGD with HIV care providers

Name of principal investigator: Mr. Solomon A. Narh-Bana
Name of institution: University of the Witwatersrand

Consent Form

I have been adequately informed of (or I have read and understood) the purpose, procedures, potential risk and benefits of this study. I have had the opportunity to ask questions about it. Any questions that I have asked regarding the recording, have been answered to my satisfaction. I know that I can refuse to participate in this study without any loss of benefit to which I would have otherwise been entitled. I understand that if I agree to participate, I can withdraw my consent at any time without losing any benefits or services to which I am entitled. I understand that any information collected will be treated confidentially. I freely agree to participate in the study and also record the discussion. After signing this document below, I will receive a copy each of the information sheet and this consent form.

Name of participant: …….

Signature: ……..

Date (dd/mm/yyyy): ----------/----------/----------

Investigating team Member

I have adequately informed the participant of the purpose, procedures, potential risks and benefits of this study. I have answered all questions to the best of my ability.

Name of field staff (code): ……..

Signature: ……

Date (dd/mmm/yyyy): ----------/----------/----------

UNIVERSITY OF THE WITWATERSRAND, SCHOOL OF PUBLIC HEALTH

Study title: ASSESSING THE FIDELITY AND DETERMINANTS OF IMPLEMENTATION: A CASE OF ACTIVE TB CASE-FINDING AND IPT INITIATION AMONG PLHIV ATTENDING HIV CLINICS IN GHANA

Consent form for recording: IDI/FGD

Name of principal investigator: Mr. Solomon A. Narh-Bana
Name of institution: University of the Witwatersrand

Consent Form for Recording

I have been adequately informed of the purpose, procedures, potential risk and benefits of this study. I am aware that the focus group discussion or in-depth interview will be audio recorded and for that reason, my participation in this study will be audio recorded. However, if I feel uncomfortable at any time I can ask that the recording equipment be switched off. I understand that I can ask for a copy of the recording. I understand what will happen to the recordings once the study is finished.

After considering all the information given to me regarding my participation in this study, I do agree to participate and give my consent to being audio recorded in this study. Also, after signing this document below, I will receive a copy each of the information sheet and this consent form.

Name of participant: …….

Signature: ……..

Date (dd/mm/yyyy): ----------/----------/----------

Investigating team Member

I have adequately informed the participant of the purpose, procedures, potential risks and benefits of this study. I have answered all questions to the best of my ability.

Name of field staff (code): ……..

Signature: ……

Date (dd/mmm/yyyy): ----------/----------/----------

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by Solomon Narh-Bana

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