

Weighted fidelity of delivery of an intervention in the health facility: a case of TB screening among PLHIV in selected hospitals in Ghana

Solomon A Narh-Bana (✉ narhbana@gmail.com)

University of the Witwatersrand

Mary Kawonga

University of the Witwatersrand

Esnat D Chirwa

Gender and Health Research Unit, Medical Research Council, Johannesburg

Selase Ofori Odopey

Dodowa Health Research Centre

Frank Bonsu

National TB Control Programme

Latifat Ibisomi

University of the Witwatersrand

Tobias F Chirwa

University of the Witwatersrand

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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.

Background

Programme implementation is vital in achieving and strengthening desired health intervention results. Effective implementation of an intervention at a health facility requires combined multi-sectoral 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, therefore 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.

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 48.3–82.8%. 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)	<i>p</i> 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 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 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 (F-test)	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.

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 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.

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.

Again, we ensured that all procedures involving human participants in this study were performed 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.

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.

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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.

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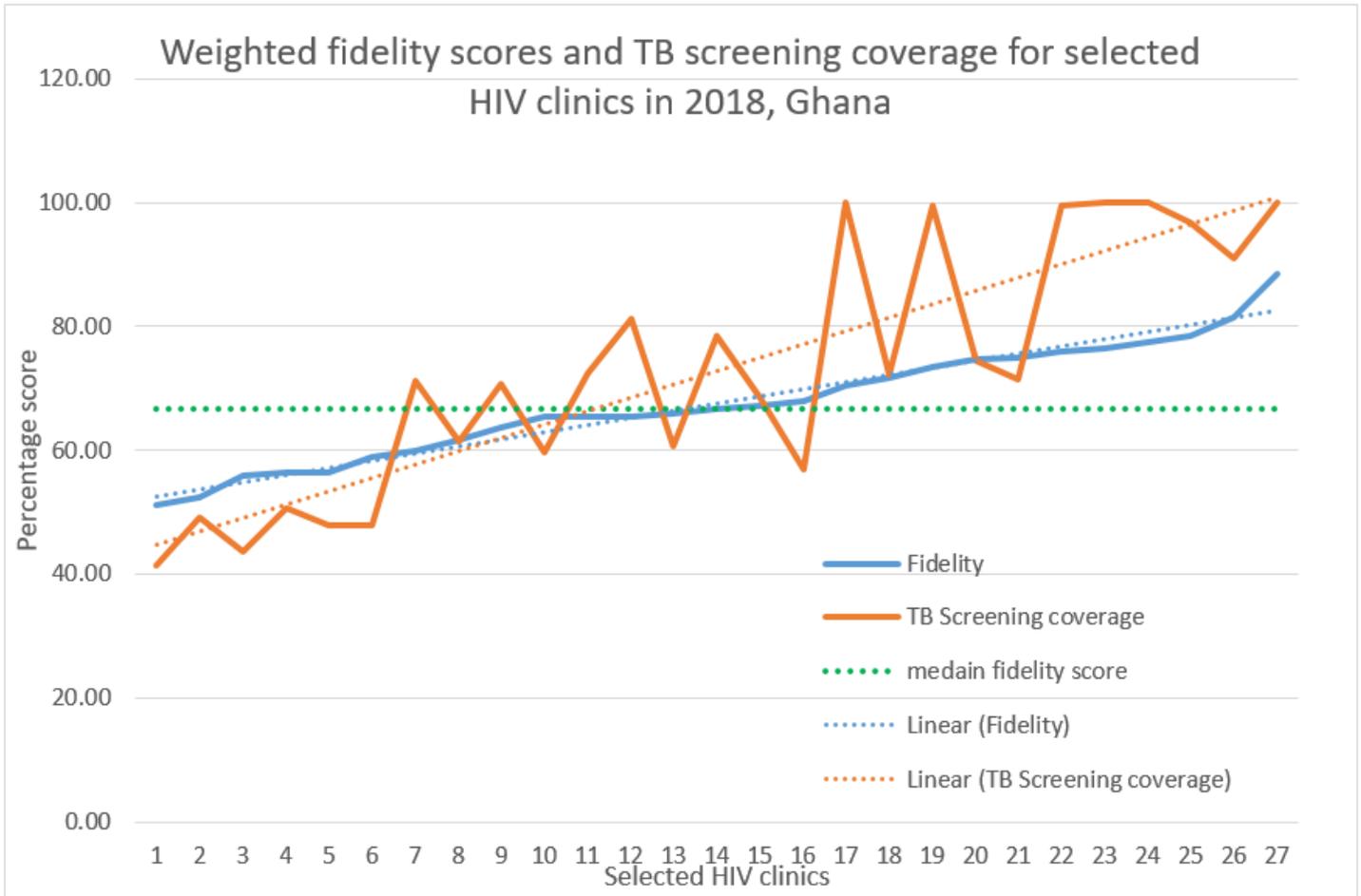


Figure 2

Weighted fidelity score and TB screening coverage in selected HIV clinics

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