Effectiveness and challenges associated with the symptoms-based screening tool for active tuberculosis case finding in outpatient departments in healthcare facilities in Ghana

Diana Akila[1], Margaret Kweku[1], Enoch Aninagyei[1], and Kwabena Duedu[1]

[1]University of Health and Allied Sciences

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Abstract

Background: Successful active surveillance for infectious disease leads to increased case detection and better management outcomes. Because of that, the National Tuberculosis Programme (NTP), Ghana introduced Symptoms-Based Screening (SBS) Tool for TB case finding. Despite these efforts, Ghana has not achieved the 10% target of TB screening in all out-patient departments attendees as recommended by the NTP. Therefore, this study determined the challenges and limitations of the SBS Tool used for active tuberculosis case finding in Ghana. Methods: This study targeted presumptive TB patients resident in Ho Municipality, Ghana. Presumptive TB patients, recruited from Ho Teaching and Ho Municipal Hospitals, were screened with the SBS tool and presumed TB patients tested for M. tuberculosis using microscopy and positive samples confirmed by geneXpert technique. Also health personnel were interviewed to assess the user-friendliness, challenges and limitations associated with the SBS tool. Chi square association of categorical data was done by STATA version 14.1. P-values <0.05 was considered statistically significant. Results: From both hospitals, 636 presumptive patients and 24 health workers participated in this study. Of the total patients screened, 1.73% had active tuberculosis. Coughing for $>$ 2 weeks ($x2=24.8$; $p<0.05$); chest pains ($x2=28.3$; $p<0.01$) and night sweat ($x2=34.8$; $p<0.05$) associated significantly with M. tuberculosis infection status. The main challenge associated with the SBS tool was its unfriendliness for administration while lack of enough indicators to identify other vulnerable individuals to TB (diabetics, cigarette smokers, alcoholics, immunocompromised and malnourished individuals) limited the sensitivity of the tool. Conclusion: The SBS tool was found not to be sensitive enough to identify infected cases. Inclusion of signs and symptoms of diabetes, immuno-suppression and malnutrition in the current tool and subsequent training of all relevant health personnel on the use of the tool could contribute to increase the sensitivity of the tool.

Background

There are two outcomes of TB infection; latent and active. Many people exposed to the TB bacilli are immuno-competent and remain asymptomatic[1,2]. Several factors make people more susceptible to TB infections; people living with HIV/AIDS, chronic lung disease, smoking cigarettes, excessive drinking of alcohol and diabetics[3,4]. Tuberculosis is also linked to overcrowding and malnutrition and among group of people with limited movement like prisoners [5]. Students in hostels are also at a higher risk of infection. Again, resource poor community dwellers and children who are in close contact with infected patients are also at risk[6,7].

In latent TB, the bacteria remain in the body in an inactive state. There are no symptoms associated with this and the affected individuals are not contagious. This can however transform to an active form of the disease. Active TB is associated with various clinical symptoms and the affected individuals can transmit the organisms to others[8]. About one-third of the world's population is believed to have latent TB. In addition,

there is a 10 percent chance of latent TB becoming active, but this risk is much higher in people who have compromised immune systems, i.e., people living with HIV or malnutrition, or people who smoke[8].

TB remains a major public health problem in Ghana despite the progress made in combating TB over the past years. In 2014, the estimated national prevalence of TB in Ghana was 282 (95% confidence interval: 111 - 530) per 100,000 population [9]. An estimated 14,668 new cases of TB were reported in Ghana in 2014 and Ghana's case detection was 33% which was below the African regional average rate of 47% and the WHO target of 70% [9]. The quest to improve on case detection using a Symptoms-Based Screening Tool (Chest Infection) for TB active case finding in health facilities is key in Ghana Tuberculosis control programme.

There have been some efforts to scale-up the systematic TB screening to all districts in the Volta Region yet they still do not achieve the 10% target of TB screening in all OPD attendees as recommended in the National Tuberculosis Programme (NTP). The overview of 2017 annual performance review of tuberculosis in the Volta Region revealed that out of General OPD attendance, 8.2% were screened for TB out of which 1.2% were picked as presumptive TB cases. The Ghana National TB control programme has taken several steps including the introduction of Symptoms-Based Screening Tool (Chest Infection) for TB active case finding in health facilities to increase case detection rates with the aim of addressing the low case detection in the country.

Despite the progress made in combating TB over the past years, there is still gap in TB case detection in the country and the region. This study was designed to determine the effectiveness of the Symptoms-Based Screening Tool (Chest Infection) for TB active case finding in two health facilities in the Southern part of Volta Region, Ghana. Specifically, this study determined the prevalence of TB among patients presenting at the OPDs of these two hospitals following initial screening with the Symptoms Based Screening Tool and also determined the challenges faced by practitioners and factors limiting the sensitivity of the screening tool.

Materials and methods

Study Design

This study was a health facility-based cross-sectional study that took place from December, 2018 to January, 2019 in Ho Teaching and Ho Municipal hospitals in the Volta Region, Ghana. Clinical nurses administered the Symptoms-Based Screening Tool (SBS) for TB active case finding at each consulting room in the hospitals. Two sputum samples were collected from each presumptive patient for the determination of tuberculosis bacilli in the Regional Hospital Laboratory, Ho.

Study site description

The study was carried out in the Southern part of the Volta Region of Ghana. The then Volta region was divided into 25 administrative districts (now Oti region has been carved out of the then Volta region). Ho is the capital of the Ho Municipality and also the Volta Regional capital. Ho is a cosmopolitan city with brisk economic, social activities as well as several tourist attraction sites. Again the Municipality has several second cycle instructions, nursing training colleges, colleges of education, technical university and health and allied sciences university as well as several private universities. Also there is a big market and other small markets in the Municipality. This attract a lot of people into the Municipality and overcrowding is a frequent occurrence. The two biggest hospitals in the Municipality were Ho Teaching Hospital and Ho Municipal Hospital.

Training of data collection team

The data collectors were trained nurses at the health facilities where the study was done. They were trained for 2 days. The primary language in the region is predominantly Ewe, hence role plays were done in Ewe with minimal Twi (the most popular local language in Ghana) and English (the official Ghanaian language). Ten (10) nurses were trained at each facility for the data collection. Pre-testing of the survey tools was done during the training period in the Ho Municipal hospital. This afforded the team the opportunity to have practical experience with the administration of the study tools.

Inclusion and exclusion criteria

Individuals aged 15 years and above who were residents of communities that were selected for the study were eligible for inclusion. This age range was selected because per NTP protocols, persons 15 years and over are classified as adults and they can produce good sputum for microbiological analysis. Additional inclusion criterion was cough for two weeks or more. Written consent was obtained from all the study participants. Persons excluded from the study were seriously ill patients who could not provide informed consent as well as those that could not produce sputum. All other presumptive tuberculosis patients that did not fall within the study criteria were managed routinely by existing tuberculosis management protocols in Ghana.

Sample size estimation

The sample size for this study was calculated using the formulae below:

$$N=\frac{\mathbf{Z^2P\ (1-P)}}{e^2}$$

Where: N = calculated sample size, Z = Z score (reliability co-efficient) of 1.96 at 95% confidence interval, P = Prevalence of 0.282 which was the prevalence of TB per 100,000 population in the Volta region for the year 2017 (Volta Regional Health Directorate, 2017) and e = margin of error (0.05).

Using the above formula, the sample size was calculated to be 311. Adjusting for 5% non-response rate, the minimum sample size of 327 was used for this study.

Sampling of participants

Patients who met the inclusion criteria were recruited into the study at both the OPD and in the consulting rooms for each health facility. All patients who visited the two hospitals during the study period and consented to participate in the study were sampled. Those who consented to participate were screened at a designated place at the OPD to ensure privacy and confidentiality.

Administration of SBS tool

A Symptom-based screening (SBS) tool (adapted from an existing National Tuberculosis Control Programme screening tool) was administered to presumptive TB patients who satisfied the inclusion criteria. The SBS tool was administered to individuals who complained of coughing for two weeks or more. Other variables were collected: age, sex, cough of any duration, chest pain, weight lost, night sweat, fever. Anyone who met the aforementioned criteria was classified as patients with presumptive TB and sputum was collected from them for examination for *M. tuberculosis* . Also, health workers who manage TB patients were also interviewed on the challenges associated with the SBS tool.

Assessment of challenges and limitations of the SBS tool

Twenty-four health personnel of different cadres, randomly selected from each of the two health facilities, were interviewed to assess the user-friendliness, efficiency, challenges and limitations associated with the SBS

tool. A semi-structured questionnaire was used to elicit responses.

Sputum collection for TB diagnosis

As recommended by National Tuberculosis Control Programme, two sputum samples were collected from each presumptive *M. tuberculosis*individuals; spot sample and second sample after one hour. Presumptive*M. tuberculosis* individuals were instructed on how to induced sputum production. They were made to cough three times, after taking a deep breath to produce sputum. Sputum collected were kept in tight containers and transported to the laboratory within 24 hours for microbiological examination.

Microscopic detection of *M. tuberculosis* in sputum samples

Sputum examination was done in the Ho Teaching Hospital Laboratory by two experienced Biomedical Laboratory Scientists. Standard size sputum smears were prepared and labelled on a slide before heat fixing. Ziehl Neelsen staining technique was used to examine the smear for presence of acid-fast bacilli. Briefly, carbol fuchsin was flooded on the dried smears, heated briefly till steam just appeared and left to stand for not less than 5 minutes. The stain was tipped off and decolorized with dilute sulphuric acid (20% v/v strength) for exactly 5 minutes. The decolorizer was tipped off and the smears counterstained with 0.3% (w/v) Methylene blue for 1 minute. Smears were air and examined using x100 objective of the light microscope for presence of acid-fast bacilli. A portion of the eleven microscopy samples were analyzed using the GeneXpert machine for confirmation of the presence of tuberculosis.

Confirmation of M. tuberculosis by using geneXpert PCR technique

MTB/RIF geneXpert analyzer operate on the principle of real-time polymerase chain reaction. Detection of *M. tuberculosis* was done according to the manufacturer's recommendation without any modification. Briefly, sample processing control (SPC) was added to sputum samples in a ratio of 3:1. The specimen together with the SPC was vortexed vigorously for a minute, incubated at 25 °C for 10 minutes, vortexed again for a minute and incubated again for 5 minutes. With the help of a sterile Pasteur pipette, 2 mL of the homogenized sample was transferred into Xpert MTB/RIF cartridge and run on the geneXpert analyzer using recommended programme.

Procedure for HIV screening

All eligible participants who agree to be tested for HIV were referred to the HIV Counselling and Testing Unit of the hospital for counselling before being tested for HIV using rapid diagnostic test (RDT) (First response HIV1&2 kits, Premier Medical Corporation Ltd., Kachigam, India).

Data analysis

Study data were recorded on Microsoft excel spreadsheet (2016) and were subsequently verified for inconsistencies, completeness and accuracy. Data were then exported to STATA version 14.1 for analysis. Simple frequencies and percentages were used for categorical variables while Chi-square was used to determine the association between the dependent (prevalence of pulmonary TB) and independent variables p-value <0.05 was considered statistically significant.

Results

Demographic characteristics of the presumptive people with *M. tuberculosis*

A total of 636 presumptive people with *M. tuberculosis* were sampled from Ho Teaching Hospital (HTH) and Ho Municipal Hospital (HMH). Majority of presumptive cases in each demographic indicator was females and patients above 60 years. Christians were in the majority so as married individuals. Frequencies of these and other parameters are presented in Table 1. Table 2 represents the demographic profile of the health workers who consented to answer the study questionnaires. In all 24 health care workers provided responses to the study questionnaire. Most of the workers in both facilities were aged 23-33 years. Whereas most of the staff were married in HMH, single staff dominated in VHR. Almost all the staff have had tertiary education with majority of them being Ewes. The dominant cadre of staff that were interviewed were nurses.

Prevalence of *M. tuberculosis*and Sensitivity of the TB symptoms-based tool

In all, 4 and 7 positive cases were recorded in HTH and HMH respectively representing 1.24% and 2.17% HTH and HMH respectively. The overall prevalence of tuberculosis found in the two health facilities was 1.73%. The overall sensitivity of the SBS tool in detecting *M. tuberculosis* was 1.7% while the hospital related sensitivities were 1.2 % and 2.2% in HTH and HMH respectively.

Preferred department of administration of TB symptoms-based tool

The preferred location of screening for *M. tuberculosis* using SBS was the OPD Front Desk. However, the difference in the cases recruited from OPD and consulting rooms was not significant (x^2=1.007, p=0.316). Similar observation was made for each of the 2 health facilities (Figure 1).

Association between *M. tuberculosis* infection status and symptoms

There was a statistically significant association between TB infection status and cough more than 2 weeks (x2=24.8; p<0.001); chest pain and *M. tuberculosis* status (x^2=28.3; p<0.001) and night sweat and *M. tuberculosis* infection status (x^2=34.8; p<0.001 (Table 3).

Implementation challenges associated with the SBS tool

Of the total staffs, 15 (62.5%) did not have any challenges administering the tool while 9 of them had some challenges with the tool. The common challenges identified were inadequate health staff, lack of patient's cooperation to provide responses, font sizes being too small, too many questions and filling hard copies of several questions is cumbersome and boring.

Limitations of the SBS tool

Inability of the tool to capture other risk groups such as diabetics, cigarette smokers, alcoholics, immuno-compromised and malnourished individuals was reported by the health care providers as the main limitation of the tool.

Discussion

In *M. tuberculosis* infections, only one in 10 exposed humans will be susceptible to the infection, hence develop active tuberculosis. Again, in susceptible individuals, half (50%) will develop TB within 1–2 years of exposure and the remaining 50%, active infection can be developed at any other time [10]. Inactive tuberculosis infections occurs when humans are infected with *M. tuberculosis*bacilli without any overt clinical symptoms,

radiological abnormality or microbiological evidence [10]. The estimated prevalence rate of inactive TB in low- or middle-income countries is as high as 51.5% while in high-income countries the estimated prevalence rate is 28.1% [11]. It has also been reported that most new clinical TB cases originate from progression of inactive TB[12,13], therefore active case search to detect both inactive and sub-clinical TB is a useful strategy for reducing TB prevalence.

This current study screened 636 people with TB out of which 1.73% (1730 per 100 000 population) infected with *M. tuberculosis* . A similar study in Ethiopia reported higher prevalence (4.4%) of identified TB cases [14]. Similarly, in Tanzania, 4.1% of TB were detected in people with TB screened with the Symptoms-Based Screening Tool [15]. The differences in the prevalence reported in these studies could be as a result of the differences in study population in each study. In the study reported by Menberu[14] and Shayo et al. [15] the screening tool was administered to HIV-infected persons with TB. So it was not surprising they had relatively high prevalence of TB among the participants. HIV infections lead to host immunosuppression and thereby rending the host susceptible to *M. tuberculosis* infections. Again, HIV is the most important risk factor for tuberculosis[16]. In contrast to this study, all the presumptive people with TB were negative for HIV based on the rapid testing kit. However, findings in this study underscore the fact that the infected cases could have been missed but for the implementations of the SBS tool. A lower prevalence was reported in our study could be due to the fact that the study was carried out in an urban population.

Considering the socio-economic nature of Ghana, communal living and communal activities are very common. If the infected individuals are not treated promptly, they will remain continuous high risk source of infection to their contacts. As soon as people with TB begin standard TB medication, their infectiousness reduces. Previous studies found that after anti-TB chemotherapy, *M. tuberculosis* bacilli burden is reduced to approximately 4% of the initial bacilli load within 48 hours start of treatment and to 1% within 2–3 weeks of anti-TB chemotherapy in drug-sensitive TB patients [17,18].

Detection of only 1.73% of the presumptive TB cases reveals the lack of sensitivity of the screening tool even though geneXpert is very sensitive and specific for MTb. However, analysis of data obtained in this study concluded that there were strong association between cough more than 2 weeks, chest pain and night sweat, and TB infections status. It is imperative that clinicians survey for these symptoms, irrespective of the clinical complains and get them tested for tuberculosis using geneXpert.

Few operational limitations to the use of SBS tool were identified in this study. The health workers indicated that the screening tool is laborious to administer. Likewise, Reid and Shah[19]also reported that similar screening tool available to them was not user-friendly. Another major limitation identified by the health providers was the inability of the tool to capture other risk groups such as individuals with chronic lung disease, cigarette smokers, chronic alcoholics, diabetics, pregnant women in their 2nd trimester, prisoners, individuals with prolong stay in overcrowded environments (market women, students in hostels etc) as well as malnourished individuals. Also the tool did not allow for screening of people who live in resource poor communities like slums. These individuals have been found to be at higher risk of tuberculosis disease [3-7,20].

Conclusion

This study was able to identify some patients infected with TB in the study area. This underscores the fact that active Tb case search is very important exercise in identifying cases that would have hitherto been lost. Such individual pose threat to public health and disrupt national program efforts. Even though the current SBS tool has some challenges, it could be simplified to make it user-friendly and also redesigned to capture other high-risk groups.

Declarations

Ethics approval and consent to participate

Ethical approval was sought from the Research Ethics Committee (REC) of the University of Health and Allied Sciences, Ho, Ghana. Each participant signed an informed consent form prior to participation. The informed consent form was approved by the ethics committee prior to use.

Consent for publication

Not applicable

Availability of data and materials

The data for this study is available at the respective hospitals (HTH and HMH) and not accessible online. The data may be made available upon written request to through the authors, provided the request complies with the Ethical Review Committee guidelines.

Competing interests

The authors declare that they have no competing interests.

Funding

No direct funding was obtained for this study. The laboratory analysis was conducted in the respective health facilities as part of routine tests.

Authors' contributions

MK and KD conceived and designed the study, DAA contributed to evaluation of the study design and data collection. EA drafted the manuscript. All authors contributed to data analysis and interpretation as well as read and approved the manuscript.

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FIGURES

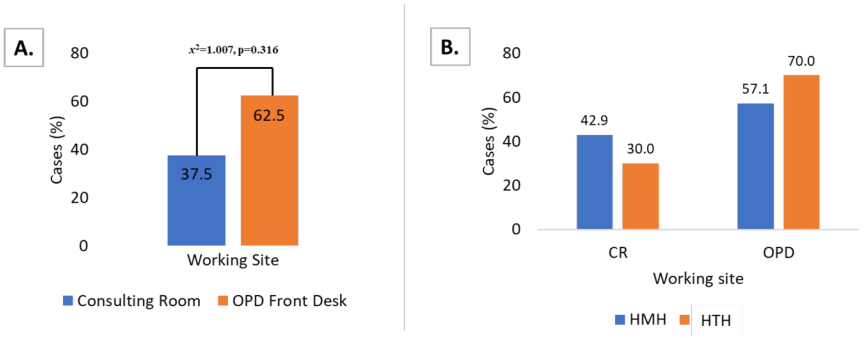

Figure 1: Departmental and health facility specific for the administration of the SBS tool for *MTB* screening by Health Workers .

A. Overall preferred site for the administration of the tool and **B.** Distribution of the preferences within the respective health facilities studied.

Key: HTH = Ho Teaching Hospital; HMH = Ho Municipal Hospital; CR = Consulting Room; OPD = Out Patient Department Front Desk; SBS-sympton-based screening

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