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Feasibility of district wide screening of health care workers for tuberculosis in Zambia

Suzanne Verver^{1,2*}, Nathan Kapata³, Mathildah Kakungu Simpungwe⁴, Seraphine Kaminsa^{5,6}, Mavis Mwale⁷, Chitambeya Mukwangole⁵, Bernard Sichinga^{5,8}, Sevim Ahmedov⁹ and Max Meis¹

Abstract

Background: Many health care workers (HCWs) are at increased risk for tuberculosis (TB). The World Health Organization (WHO) recommends screening HCWs for TB in high burden settings but this is often not implemented in countries with a high TB incidence. We assessed the feasibility of TB screening among HCWs, including participation rate and yield, as part of a project introducing facility specific TB interventions.

Methods: This study had a cross-sectional design. HCWs (including paid staff and community volunteers) from 13 clinics and two hospitals in the Ndola district of Zambia participated. HCWs were screened by a designated person in their own facility. The agreed screening algorithm for HCWs included annual symptom screening, with sputum smear, culture (or Xpert) and chest x-ray offered to HCWs with at least one TB symptom, i.e. those with presumptive TB.

Results: A total of 1011 out of 1619 (62%) staff and 71 out of 138 (51%) community volunteers were screened within one year, total 1082/1757 (62%). Five percent (52/1082) of those screened were presumptive TB patients. Seventy-three percent (38/52) of presumptive TB patients received all diagnostic tests according to the agreed algorithm. Eighteen out of 1757 staff and volunteers combined were diagnosed with TB within a calendar year, showing a notified TB incidence of 1%. At least five of them were diagnosed during the screening appointment (0.5% of those screened). One of the 18 HCWs died of TB. Seventy-six percent (822/1082) of screened HCWs indicated that they already knew their HIV status. Screening was considered feasible if confidentiality can be guaranteed although challenges such as the time required for screening and sample transport were reported.

Conclusions: It is feasible to conduct and implement screening programs for TB among HCWs in hospitals and clinics, and the notified incidence and yield is high. Advocacy is needed to educate managers and HCWs on the importance of screening and the implementation of locally relevant screening algorithms. It is essential to ensure access to TB infection control, diagnostics, treatment and confidential registration for HCW.

Keywords: Tuberculosis, Health care workers, Screening

Background

It has been proven that in many settings the burden of tuberculosis (TB) is two to four times higher among health care workers (HCWs) than among the general population, both in large reviews [1–3] and in studies published after these reviews [4–7]. TB Surveillance among HCWs is

important, both to support individual HCWs with treatment support and because it can be a proxy indicator for infection control (IC) practices [8]. A limitation of this indicator is that it can be influenced by the general health status of the HCWs and their possible exposure to TB in their community. It is essential to introduce national policies that ensure priority access to TB care for HCWs, and Provider Initiated Testing and Counselling (PITC) for HIV [9, 10]. HCWs have been mentioned as a possible risk group for screening in the World Health Organization (WHO) guidelines on TB screening [11].

* Correspondence: suzanneverver@hotmail.com; s.verver@erasmusmc.nl

¹KNCV Tuberculosis Foundation, Benoordenhoutseweg 46, 2596 BC The Hague, The Netherlands

²Currently: Dept. of Public Health, Erasmus MC, Wytemaweg 80, 3015 CN Rotterdam, The Netherlands

Full list of author information is available at the end of the article



The screening of HCWs for TB can lead to early case detection and treatment, thereby reducing TB related morbidity and mortality, worker absenteeism and hospitalizations, and helping to retain a healthy workforce. Screening can also identify the areas in health facilities where HCWs are most at risk by calculating in which areas the proportion of HCW with TB over multiple years is high. There is little evidence that the screening of HCWs can reduce transmission [11], but in other risk groups such as migrants, screening has proven to reduce the severity of disease and has the potential to reduce transmission [12, 13].

It is recommended to routinely screen HCWs for HIV, not only after needle stick injuries [14]. HIV infected HCWs should be moved to areas with less risk of TB [9]. Several studies and the WHO recommend HIV screening specifically for HCWs as part of routine occupational health and safety activities [11, 15, 16].

In Zambia and most high TB burden countries, surveillance of TB among HCW is only performed through passive case finding [17]. In many African countries, screening has not been implemented on a national scale or under sustainable routine programme conditions, with the exception of some hospitals and research projects [7, 10, 18]. In most countries the screening of HCWs for TB does not happen at all or is limited to pre-employment screening, usually consisting of chest x-ray (CXR). There is also no routine screening for HIV or other blood borne viruses. Before 2007, only 33% of the HCWs in five Zambian hospitals had been tested for HIV in a cross-sectional study [19], and the large majority of HCWs feared getting infected with HIV in the workplace [20]. Only one study on TB among HCWs in Zambia was found. In this study a large university teaching hospital in Zambia reported an increase in TB incidence among nurses from 0.3% per year between 1982 and 1984 to 2.4% per year between 1999 and 2005 [21].

We conducted an evaluation with the aim of assessing the feasibility and acceptance of HCW screening for TB in a district setting that had different types of health facilities, under routine programme conditions. The specific objectives were to assess participation rate and yield of screening for TB among HCWs. A secondary objective was to assess what proportion of HCWs knew their HIV status and had been tested for HIV in the last year. To our knowledge, this is the first report from Sub-Saharan Africa (outside South Africa), of an attempt to implement district wide screening for TB among HCWs, under programme conditions.

Methods

Country setting

In Zambia the estimated TB incidence in 2014 (the time of the project) was 406/100,000, one of the highest in

the world, and this seems to be on the decline [22]. The notification rate was 241/100,000 in 2014 [23]. Most recent data show that the WHO estimated incidence was 391/100,000 and the notification rate was 260/100,000 in 2015 [24]. WHO estimated that 60% of all TB patients were also co-infected with HIV [24].

TB control is implemented by the National TB control Programme (NTP), under the Ministry of Health (MoH). The national TB Infection Control (IC) guidelines include the recommendation to remind HCWs and other staff that they can develop TB and to ensure that they know the signs and symptoms of TB and immediately report such signs and symptoms to their supervisor [25].

District setting

This screening programme was part of a bigger project introducing a combination of facility specific TB IC interventions such as the triaging of patients and the improvement of ventilation. The project took place in the Ndola district in the Copperbelt Province of Zambia [23] which has the second highest TB and HIV burden in the country.

In the Ndola district the TB notification rate was 581/100,000 population in 2013 [26], 465/100,000 in 2014, 374/100,000 in 2015 and 362/100,000 population in 2016 [personal communication, co-author MKS]. We included the 15 largest health facilities with a TB diagnostic laboratory in the district, specifically the 13 larger clinics, the provincial Ndola Central Hospital (NCH), that includes an MDR-TB treatment facility and the regional reference laboratory (Tropical Diseases Research Centre, [TDRC]), and the Arthur Davison Children's hospital.

Design and participants

We used a cross-sectional design, in which each HCW was intended to be screened once over the course of one year. The participants were all staff working in the 15 facilities and included laboratory staff, administrative staff, support staff such as cleaners and drivers, and registered TB community volunteers (who assist the health facility with TB case finding and support TB patients with taking treatment). For the purpose of this paper, all were considered to be HCWs, as they all have an increased risk of exposure to undiagnosed and/or diagnosed TB patients. As routine practice, HCWs were encouraged to report to the assigned screener if they had any TB related symptoms throughout the year.

Implementation steps

The project partners were: the Ministry of Health (MoH), KNCV Tuberculosis Foundation, FHI 360, the Provincial Medical Officer and the District Community Medical Officer in Ndola. The first introductory meetings were held

with the district leadership in order to introduce the screening of HCWs as part of the broader TB IC project. This was essential to ensure ownership and sustainability of the activities. Thereafter a baseline assessment was held that consisted of structured individual interviews with leaders from the NTP, the Provincial Medical Office, the District Medical Office, facility heads (facility in-charges) and a convenience sample of HCWs from most of the participating facilities. We sought to gather their opinions on the attitudes, feasibility, acceptability, potential resources needs and operational aspects of setting up a HCW TB screening program. The results of these interviews were used to develop the screening protocol and feedback on the proposed screening tool and TB screening registers was recorded.

At least three group meetings (baseline, start-up, training) were held for all participating facility in-charges, participants and screeners. Three additional visits were made to each facility to explain procedures and provide start-up support for the recording tools. At each clinic a senior and trusted clinician was assigned by the facility-in charge to perform the screening and keep the confidential records. The project provided supplies for laboratory culture, chest X-ray (CXR) films, forms, box files and lockable cabinets. The project partners made regular visits to the clinics and hospitals to collect data and discuss the results.

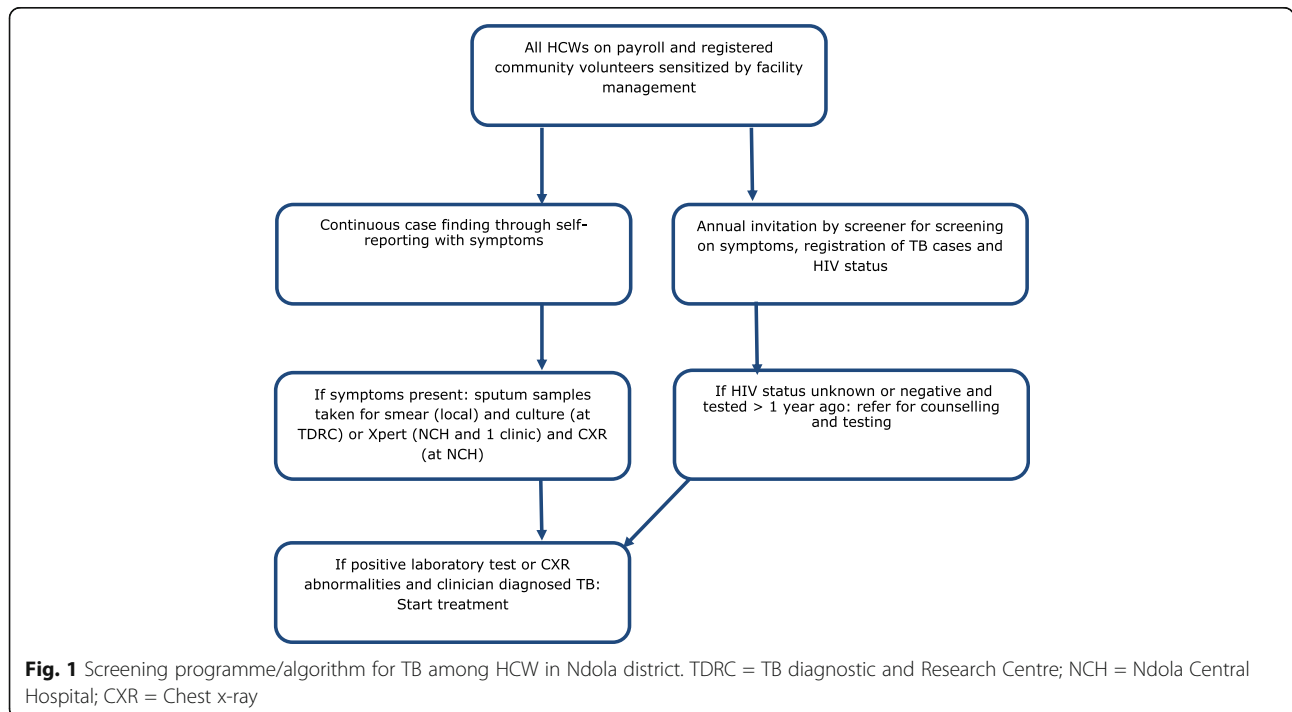
Screening

The screening was conducted from April 2013 to May 2014 (Fig. 1). The facility in-charges ensured that

all the staff in their facilities were informed about the programme, e.g. during staff meetings. Each HCW was verbally invited for TB screening by the assigned screener. The screener and HCW made an appointment at a mutually convenient time. HCWs who had TB symptoms outside the screening appointment were encouraged to contact the screener. The screener used a standard short questionnaire which was administered face-to-face in their own facility and in a confidential manner. The questionnaire included questions on any TB symptoms and their duration, TB contacts, HIV status, and past TB disease. The participation rate in the screening was considered a proxy for acceptance.

Those HCWs with symptoms (either during the screening appointment or before/after) were offered sputum smear testing, as recommended by the NTP for any presumptive TB patient (previously called a TB suspect). Persons with presumptive TB were referred by the screener for sputum smear testing, with a request for two sputum samples, a free service that is usually available in their own facility. In addition, sputum was sent for culture at the TDRC. Culture was carried out according to national standards with external quality assurance by the national reference laboratory. The presumptive TB patients were also screened with a CXR at the NCH.

The Xpert® Mtb/Rif test (Xpert) which is a molecular technology that simultaneously detects *Mycobacterium tuberculosis* (Mtb) and Rifampicin resistance, became available at two facilities including the NCH, in September 2013, midway through the study. Since then, the national



TB diagnostic algorithm for Xpert included HCWs in addition to people living with HIV, meaning culture could be replaced by Xpert.

HCWs were also asked if they had been tested for HIV in the previous year. Those not tested in the previous year and not known to be positive were referred for PITC. All presumptive TB patients and TB patients were also offered PITC for HIV.

HCWs with TB were encouraged to disclose their TB status to their facility-in charges following screening, as this was not done by the screener. The total number of HCWs diagnosed with TB during the period of the screening programme was not available. The total number of HCWs diagnosed with TB during the calendar year 2013 was used as an approximation of the HCWs diagnosed during the 12 months of the screening programme (April 2013 through May 2014). For comparison, the number of HCWs with TB in 2012 was also recorded. These data were collected by interviewing the facility in-charges.

Feasibility

Screeners and facility in-charges were individually interviewed with open ended questions about the willingness of HCWs to participate, the success factors and any challenges which were encountered, including the time needed for screening. Their answers to open questions on success factors and challenges were frequency counted and summarized by theme. The average time needed for screening was analysed by facility type.

Data collection and analysis

A set of simple screening forms and aggregated summary forms based upon an international guide were developed [27]. The data were anonymized by a personal identification number and all the forms containing personal identifiers were kept in a lockable cabinet in the facility, provided by the project. One form (kept by the screener) linked the name and address of the HCW with his or her unique ID number to allow for the identification of the participant if follow-up activities were required.

Aggregated summary reports were prepared by the screener, with assistance from the District Community Medical Office (DCMO) and project staff. These included the number of HCWs screened by cadre and facility, the reasons for non-response (if given), the number of presumptive TB patients, the type TB diagnostic tests done, the number of HCWs diagnosed with TB and starting TB treatment, the number of HCWs tested for HIV in the last year, the number of HCWs who knew their HIV status, and the number of HCWs who tested HIV positive in the last year. Only aggregated summary reports were collected by the project staff. They could not access individual results. Aggregated data were entered

into an Excel spreadsheet and analysed by the researchers. The participation rate was calculated by dividing the number of HCWs who were screened by the number of HCWs employed (including registered community volunteers). The yield was calculated in two ways: firstly by dividing those with TB symptoms (presumptive TB patients) over the number screened (presumptive TB yield), and secondly by dividing those diagnosed with TB by the number of HCWs screened (TB disease yield). The notified incidence was calculated as the total number of HCWs diagnosed with TB in a year divided by the number of registered staff working in the facilities (paid and community volunteers).

Results

Participation in screening

Between April 2013 and May 2014 a total of 1082 HCWs were screened for TB. The paid staff accounted for 93% (1011/1082) of the total screened. There were 1619 paid staff and 138 community volunteers in the participating facilities, a total of 1757. Therefore, 62% (1011/ 1619) were screened out of the total paid staff and 51% (71/138) were screened out of the community volunteers. The mean participation rate (proportion, also called coverage or proportion screened), was 254/454 (56%) from the 13 participating clinics; 723/952 (76%) from NCH and 34/213 (16%) from the children's hospital (Table 1). The participation was between 50% and 70% for most cadres, except administrative staff had a higher participation rate of 88% and classified daily employees (mainly cleaners) and laboratory staff had a lower participation rate of 47% and 37%, respectively (Fig. 2).

Yield of TB screening

There were 52 participants (4.8%) who were presumptive TB cases out of those who were screened (1082), 4% in hospitals and 10% in clinics (presumptive TB yield). Out of those identified as presumptive TB patients, 31% (16/ 52) had at least one sputum smear examination; 8% (4/ 52) had culture examination done; 38% (20/52) got Xpert tests and 73% (38/52) had a CXR. A total of 40 (77%) had at least one laboratory sputum test. Seventy-three percent (38/52) of presumptive TB patients received all diagnostic tests according to the agreed algorithm. The summary reports that were prepared by the screener did not contain a question on whether TB patients were detected (first suspected) during the screening appointment, or had been found with presumptive TB already before the screening, or later after the screening. We attempted to collect this information by interviewing the screening clinicians at the end of the project and found that at least five TB patients among HCWs were detected during the screening appointment, giving a yield of at least

Table 1 The proportion of HCWs screened, the yield and the TB incidence

	Number of HCWs	Number screened	%	Number (%) with symptoms (presumptive TB) ^a	Number (%) with TB ^a
Total	1757	1082	62%	52 (5% of 1082)	18 (1% of 1757) of whom at least 5 (0.5% of 1082) due to screening appointment
Type of HCW					
Paid staff	1619	1011	62%		
Volunteers	138	71	51%		
Paid staff by type of facility					
13 clinics	454	254	56%		
Hospital 1	952	723	76%		
Hospital 2	213	34	16%		

^aThese data are not provided by subgroups to protect confidentiality

5/1082 = 0.5% (TB disease yield). One of these five HCWs was a community volunteer.

Notified TB incidence

The total number of TB patients in calendar year 2013 was 18 out of the registered 1757 HCWs (paid and volunteers) in the participating facilities. This indicated a notified incidence rate among HCWs of 1% (95% CI 0.6–1.6). Although not all HCWs were diagnosed at the specific screening appointment, the reported TB incidence is considered a result of the screening programme because HCWs were instructed to seek medical advice if they experienced TB symptoms between screenings. All 18 patients were started on treatment according to the national TB guidelines. As stated in the paragraph ‘yield of TB screening’ at least five out of the 18 (28%) were detected through screening and at least one of these was a treatment supporter. It was not documented whether the other 13 patients notified were detected during the screening appointment or the routine passive surveillance system, as the type of case detection (screening or passive) was not part of the aggregated TB IC indicators [27]. No drug-resistant TB was reported among HCWs during the evaluation period. All 18 HCWs with TB were

started on treatment, but one died from TB in 2013 before they completed treatment. The TB incidence among HCWs in 2012 showed a similar incidence (0.9%).

HIV

Seventy-six percent (822/1082) of the HCWs who participated in the evaluation indicated they already knew their HIV status at the time of the screening appointment; among these 59% (485/822) had been tested in the preceding year and 4% (19/485) of them were HIV infected. Those who did not know their HIV status were encouraged to go for PITC.

Feasibility

The screeners generally considered screening to be feasible. Success factors mentioned were that HCWs were well aware of the risk and were actually eager for a screening programme to start. The assurance of confidentiality was considered very important by HCWs. Researchers observed that signed informed consent forms were available for all the HCWs screened and screening forms were kept in the locked cabinets. The assignment of a trusted person as screener was mentioned as being crucial factors of HCWs participating. In the hospital

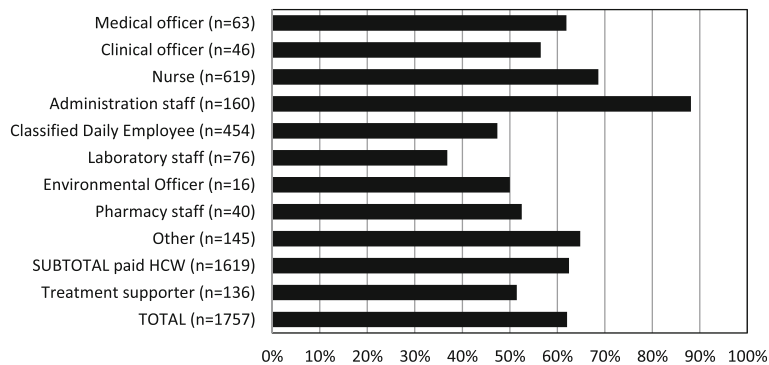


Fig. 2 Percentage of health care workers screened in the 15 facilities by cadre. Between brackets the number of HCW employed in the facilities by cadre

with a large participation rate the screener went from ward to ward to recruit HCWs for screening. Screeners reported that only short times were needed to complete the screenings (15–30 min in clinics and 15–20 min in the main hospital).

Despite feasibility, challenges were also reported. The screeners reported that in the hospitals the high number of HCWs that needed to be screened took a large proportion of their time, and therefore a dedicated screening team may be needed. Screeners reported the following reasons for non-participation: both the HCW and screener were busy, the HCW had yet to make up their mind, the HCW was screened elsewhere, some HCWs were not willing to be screened. Screeners indicated there may still be an issue with stigma when HCWs choose not to get screened or to get screened elsewhere, although stigma plays a smaller role than in the past, when TB was strongly linked to HIV and no anti-retroviral treatment was available. The reasons given for not being screened could not be systematically collected, as HCWs who did not attend often did so without giving a reason. The children's hospital screeners (the facility with lowest participation rate) indicated that finding suitable times for screening was a challenge. Some mentioned that frequent staff turnover affected the participation rate. When asked why the recommended screening algorithm was not always followed, some screeners indicated that they followed the national guidelines of awaiting the sputum smear result before performing other diagnostics. Challenges with the availability of sample transportation were also frequently mentioned.

Discussion

We found that the introduction of screening for TB among HCWs was feasible. Sixty-two percent (62%) of HCWs were screened in the 15 facilities within one year, 5% of those screened had presumptive TB, at least 0.5% of those screened had TB during the screening appointment, and the notified TB incidence among HCWs during the screening programme was 1%. The main challenges were the larger number of HCWs to be screened in hospitals and the finding that only 73% of presumptive TB patients had all the diagnostic tests specified in the screening algorithm.

The proportion of HCWs screened (62%) is similar to the weighted mean of five studies (59%) mentioned in the WHO screening guidelines for TB [11] and confirms less than optimal participation rates found in a systematic literature review in South Africa [7]. A high willingness to be screened among HCWs was reported in Johannesburg [4]. The large differences in participation between facilities shows that acceptance is not universal, and that stigma may still play a role [28, 29]. Although participation was considered a proxy for acceptance, the

characteristics of the screener (for example availability, responsibility, pro-activeness and seniority) and facility management (sensitization, priority setting) may have influenced the participation rate. The lowest participation rate was found in the children's hospital, where finding a suitable time for screening was mentioned as the main reason. Screening in the children's hospital was possibly less of a priority because children are less often smear-positive, and therefore HCWs may have considered themselves to be at a lower risk of infection.

The differences in participation rates between cadres of staff (Fig. 2) shows that more effort is needed to include classified daily employees (e.g., cleaners) and laboratory staff. Classified daily employees may be less aware of their risk than other HCWs. Laboratory workers may be more affected by stigma since their close colleagues would need to investigate their sputum sample. The high participation rate among administrative staff may be explained by sensitization. Screening attendance may increase with two screeners per facility, when it is integrated with screening for other diseases, or when screening is provided in special HIV care treatment programs for HCWs, as has been done in South Africa and Malawi [30, 31], although there is very little evidence for workplace screening programs for TB and HIV for health care workers [32]. The number of HCW in our study was too low to estimate incidence by cadre but other studies found that some cadres are at higher risk than others [2, 5].

In the recent nationwide prevalence survey 9.7% of the participants had at least one TB symptom (defined as presumptive TB), compared to our finding of 5% [32]. This may be a result of the so called healthy worker effect [33].

When we assume that those screened are representative of all HCWs (which it may or may not be as we didn't use a probability based sample), then the finding of 5% presumptive TB among HCWs, may result in $5\% \times 1757 = 88$ persons needing expensive diagnostic tests (in this programme CXR and culture or Xpert). This is a limited number of additional diagnostic tests compared to the volume of such tests that is usually done in this district. In the national guidelines, culture and CXR are usually reserved for specific risk groups. Since the onset of this programme HCW are one of these risk groups. Further study on cost-effectiveness is needed.

The agreed screening algorithm was often not followed by the screening clinicians, as shown by the low proportion of HCWs with presumptive TB who had all the diagnostic tests performed (77% had a laboratory test and 73% had a CXR). The screening clinicians indicated they tended to use the national algorithm for diagnosing TB (starting with smear microscopy alone), and had challenges with sample transport to the facilities (1 culture

and 2 Xpert sites). During baseline interviews before the screening programme started, HCWs indicated that if they had presumptive TB they were willing to cover their own transport costs. The low proportion of HCWs with presumptive TB who had a laboratory test done may also be due to stigma, as the test was often carried out in the same facility where they worked.

CXR is widely applied for presumptive TB patients in Zambia, more often than in the national guidelines, therefore HCWs questioned why not all of them had an annual CXR. Annual CXR screening would be an expensive intervention (although perhaps cost-effective). It was only added to the international screening guidelines for high incidence settings after start of our programme [11]. The screening algorithm to be selected is dependent on local epidemiology of TB and HIV. Xpert is now available and is being scaled-up in the country and is offered to all HCWs with symptoms as part of the national Xpert algorithm.

The results of HIV screening are challenging to interpret as those who are already infected do not need to be screened again. In our programme, HCWs who knew they were HIV infected may have refused to participate more often. Our results show that the proportion tested has increased since a previous study in Zambia [19], possibly because stigma has decreased. Our results also show that TB screening is a possible entry for HIV screening [34].

Strengths and limitations

The strength of this programme was that the leadership was provided by the district management and by existing government health care providers in facilities providing the screening services. As opposed to a research setting, this set-up was intended to be sustainable. The strength of the evaluation was that a variety of facilities and a large number of HCWs were included.

A limitation of the assessment was that data-analysis from aggregated data gave limited results. For example we did not always know reasons of refusal and reasons why diagnostic tests were not done for individual HCW were not always clear. Further, since the Guide on the monitoring of TB disease incidence among health care workers did not include an indicator on yield of TB disease among screened HCW, this was not included in our aggregated forms [27]. Future studies should include this.

The agreed screening algorithm, that provided only TB diagnostic tests for HCWs with symptoms, has one main limitation, namely that the sensitivity of symptom screening is low, varying from 49% for any cough to 84% for any symptom [35].

The 1% notified incidence of TB among HCWs in 2013 might be an underestimate as it was based on aggregated summary forms and interviews with facility in-

charges and therefore prone to recall bias. It is also unknown whether non-responders had a higher risk of presumptive or active TB than those who were screened. We may have missed TB patients who were diagnosed and treated elsewhere and did not disclose their TB to their facility in-charge. We expect that the majority of TB patients among HCW will be detected between screening appointments, and that the screening programme has increased awareness of the need to report symptoms early. Other studies have found that HCW are at 2–4 times increased risk of TB than the general population [1–6]. We could not confirm this, possibly due to the above mentioned reasons.

Another limitation was that we could include only one district. Further the screening period (April 2013–May 2014) was not exactly aligned with the calendar year for which the total TB incidence among HCWs was available, but as TB is a slow epidemic we do not expect that this difference will change our conclusions.

Conclusions

Screening for TB among HCWs can be implemented by district and hospital management teams. The incidence of TB among HCWs is high (1%), HCWs are willing to be screened with a similar participation rate as reported elsewhere (62%), the yield of screening is high (at least 0.5% of those screened had TB) and screening is feasible. It takes time to build the buy-in of facility management and screeners for the screening process and to implement the agreed screening algorithm, especially in large facilities. The implementation of the diagnostic algorithm needs more advocacy, explanation and follow-up and the laboratory sample transport and tracking system should be improved, for example by linking to existing transport systems or by hiring a commercial partner. Resources should be allocated to ensure access to infection control, diagnostics, treatment, logistics and confidential registration. Screening results should be included in district reports. Non-paid staff such as community volunteers should be included in HCW screening. Alternative models for screening should be investigated, such as conducting screening by rotating screening teams.

Abbreviations

CXR: Chest X-ray; DMO: District medical officer; DTLC: District TB leprosy coordinator; HCW: Health care worker; HIV: Human immune deficiency virus; MoH: Ministry of health; NCH: Ndola Central Hospital; NLTP: National Tuberculosis Leprosy Program; PITC: Provider initiated counselling and testing; PMO: Provincial Medical Officer; TB IC: Tuberculosis infection control; TB: Tuberculosis; TDRC: Tropical Diseases Research Centre; VCT: Voluntary counselling and testing; WHO: World Health Organization; Xpert: GeneXpert Mtb/Rif

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Availability of data and materials

The data and forms used are available from the first author upon request. In order to protect the privacy of the HCWs, the data on TB patients and TB suspects among HCWs by health facility will not be made available.

Authors' contributions

All the authors contributed to the protocol development, interpretation of the results and to the writing of the manuscript. SV analysed the data and drafted the first version of the manuscript. All authors approved the final version of the manuscript.

Ethics approval and consent to participate

The University of Zambia Biomedical Research Ethics committee (UNZAREC) provided approval for the project. The Permanent Secretary from the MoH gave the authority to conduct the interventions. Written informed consent was obtained from all HCWs who participated. All project staff who were not facility staff signed confidentiality statements before they were given access to the data.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interest.

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Author details

¹KNCV Tuberculosis Foundation, Benoordenhoutseweg 46, 2596 BC The Hague, The Netherlands. ²Currently: Dept. of Public Health, Erasmus MC, Wytemaweg 80, 3015 CN Rotterdam, The Netherlands. ³Ministry of Health, Haille Selassie Avenue, Ndeke House, P.O. Box 30205, Lusaka, Zambia. ⁴Ndola District Medical Office; 1307, Naidu Close, Kanini, Ndola, Zambia. ⁵FHI 360, Plot 2374 Farmers Village, ZNFU Complex Tiyyende Pamodzi Road, Off Nangwenya Road, Showgrounds, PO Box 320303, Lusaka, Zambia. ⁶Currently: KNCV Tuberculosis Foundation, Lilongwe, Malawi. ⁷FHI 360, Zambia Prevention, Care and Treatment Partnership II, 46 Chintu Avenue, Northrise, P.O. Box 71807, Ndola, Zambia. ⁸Currently: Food and Nutrition Foundation, Lusaka, Zambia. ⁹USAID, Bureau for Global Health, TB Team, 2100 Crystal Drive 10006A, Arlington, VA 22202, USA.

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