Feasibility of two active case finding approaches for detection of tuberculosis in Bandung City, Indonesia

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Setting: A community health clinic catchment area in the eastern part of Bandung City, Indonesia.

Objective: To evaluate the feasibility of two different screening interventions using community health workers (CHWs) in detecting tuberculosis (TB) cases.

Design: This was a feasibility study of 1) house-to-house TB symptom screening of five randomly selected 'neighbourhoods' in the catchment area, and 2) selected screening of household contacts of TB index patients and their neighbouring households. Acceptability was assessed through focus group discussions with key stakeholders.

Results: Of 5100 individuals screened in randomly selected neighbourhoods, 48 (0.9%) reported symptoms, of whom 38 provided sputum samples; no positive TB was found. No TB cases were found among the 88 household contacts or the 423 neighbourhood contacts. With training, regular support and supervision from research staff and local community health centre staff, CHWs were able to undertake screening effectively, and almost all householders were willing to participate.

Conclusion: The use of CHWs for TB screening could be integrated into routine practice relatively easily in Indonesia. The effectiveness of this would need further exploration, particularly with the use of improved diagnostics such as chest X-ray and sputum culture.

Each year there are more than nine million new cases of tuberculosis (TB) globally.¹ Despite considerable efforts, the annual incidence rate is declining by only 2% per year.² The current primary strategy for passive case finding (PCF) appears to be inadequate, as a large number of TB cases remain undiagnosed.²⁻⁴ The World Health Organization (WHO) has revisited the possibility of active case finding (ACF) to complement the PCF approach.² ACF has many challenges, however, and while modelling suggests that ACF can reduce TB incidence, prevent TB deaths and reduce future costs of care, other reports have been less positive.^{3,5-8}

Indonesia has the second largest TB burden globally, with a national prevalence estimated at 647 cases per 100 000 population.⁹ Notably, half of TB patients identified in the National Prevalence Survey (NPS) were treated outside of the public system, and only half were notified to the National TB Programme (NTP).¹⁰

The use of community health workers (CHWs) for TB control has been documented in a number of different countries.⁴ Indonesia has a system of CHWs

who work alongside trained health staff in community health centres (CHCs) to carry out mother/child health and other health prevention activities. Most have a general knowledge of TB, but are not specifically trained in TB recognition, diagnosis or treatment. To our knowledge, no ACF for TB by CHWs has been carried out in Indonesia. The aim of this study was to evaluate the feasibility of two different screening interventions using CHWs in detecting active TB cases in communities in Bandung City, Indonesia.

METHODS

Study site and setting

Bandung has an estimated population of 2.5 million people. The city comprises 26 sub-districts (*kecamatan*) and 139 villages (*kelurahan*), which are then broken down into community associations (*rukun warga* [RW]). General health services, including TB diagnosis and treatment, are provided by approximately 73 CHCs. Following discussion with TB officials and the local CHC health staff, the Ujung Berung CHC catchment area, Bandung East, was selected for the study (Figure 1).

Interventions

The two interventions were 1) house-to-house symptom screening of household members in randomly selected RWs (Intervention 1), and 2) selected screening of close contacts of recently diagnosed pulmonary TB patients (index cases) and members of neighbouring households (Intervention 2).

Study participants and eligibility criteria

The eligibility criteria for participation in the study were all household members aged >10 years who consented to be screened for TB symptoms and who normally resided in 1) the households of randomly selected RWs, 2) the household of a TB index case who had had a positive sputum smear diagnosis within the last 2 years and was registered with the Ujung Berung CHC, or 3) households in the neighbourhood of an index case.

Sample size and sample selection process

For Intervention 1, we aimed to screen 4000 people. The estimated number of people needed to screen (NNS) to find one case in a medium incidence setting is 603 (25–4286).² We therefore expected to detect approximately 4–7 people with TB.

The total eligible population in the Ujung Berung catchment area was estimated at 53 717. There were 58

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KEY WORDS

active case finding; tuberculosis; Indonesia

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FIGURE 1 Location of the randomised areas, TB index cases and the subdistrict within Bandung City, Indonesia. TB = tuberculosis.

RWs in the five subdistricts; we used a cluster-sampling method to select five RWs proportional to the size of their population. A sampling interval was determined by dividing the eligible population by five. The RWs were listed according to their allocated number within each subdistrict. The first RW was chosen at random by selecting a number between one and the sampling interval number. The next RWs were selected consecutively using the sampling interval. The five randomised RWs yielded a potential population of 4676.

For Intervention 2, in 2014 20 pulmonary smear-positive TB cases were diagnosed in Ujung Berung CHC; therefore approximately 80–100 household members were eligible for screening. Based on the estimated NNS of household contacts to detect one case in a medium incidence setting (25 [3–568]),² and keeping in mind that some had already been diagnosed, we expected to find 2–3 new cases of TB.¹¹ The four closest neighbouring households of each index case household were selected. We estimated that this would provide 350–400 neighbours for screening and that only 1–2 cases might be detected.¹²

CHW training

Training for the CHWs focused on the symptoms and transmission of TB, implementation of the algorithm, consent, confidentiality, and recording and reporting, and, for Intervention 2, the process of contacting the index case and identifying the four neighbouring households. A research nurse met weekly with each CHW to provide support and to collect completed questionnaires.

Each CHW received a backpack containing data collection tools and a coolbox for sputum transportation. They were paid the equivalent of US\$3.00 for each household completed and US\$2.00 for transportation of sputum specimens.

Informed consent process and ethical approval

The study was explained to all household members and individual informed consent was obtained. Index cases were contacted by the CHWs and their consent was obtained to approach household members and neighbouring households. Individuals and households were identified by a study identification number. Ethical approval was obtained from the Human Research Ethics Committee

of the University of Otago (H15/064), Dunedin, New Zealand, and the Universitas Padjadjaran Health Research Ethics Committee (685/UN6.C1.3.2/KEPK/PN/2015), Bandung, Indonesia.

Screening algorithm and sputum collection

Each household member was asked about any previous TB diagnosis and current TB symptoms. Any individual with a cough of >2 weeks was asked to provide two sputum samples the following morning: one early morning sample and a second sample 2–3 hours later.^{13,14} The samples were collected and transported to the laboratory on the same day. If the sputum smear was negative, or if the individual was unable to provide sputum, repeat symptom screening was performed after 1 month. Any individual with a positive sputum result was asked to go to the CHC for anti-tuberculosis treatment. Each household was provided with a gift (towel) in appreciation of their participation.

Data recording and statistical analysis

Information was recorded on paper questionnaires that were collected every week by the research nurse. Data were entered into the REDCap¹⁵ electronic database (REDCap Consortium, Nashville, TN, USA) and descriptive statistical analyses were performed using Stata v.12 (StataCorp, College Town, TX, USA). A binomial exact test was used to estimate 95% confidence intervals (CI).

Focus group interviews

To assess the acceptability of the screening process, we undertook three focus group interviews with CHC staff and a random selection of CHWs and household members. Key topics covered included difficulties, communication pathways, training and support and suggestions for improvements. Interviews were recorded, transcribed and cross-checked, and main themes were identified.

Cost analysis

We performed a cost analysis for setting up and running each intervention.¹⁶ Recurrent costs included personnel, supplies and 'other' (database entry, travel). The capital cost was for CHW training. The total cost for each intervention was divided by the number of people screened, and by those with TB symptoms. All costs were converted from Indonesian rupiah to US dollars using the 2015 exchange rate.¹⁷

RESULTS

Intervention 1

The CHWs visited a total of 1537 households and screened 5100 (99.9%) eligible household members (Table 1). The mean age was 30 years (range 10–90); 51% were female. A total of 144 people reported ever having a TB diagnosis, of whom 29 had received their diagnosis in 2014–2015 (325 cases per 100 000 population per year, 95%CI 217–466). The most frequent location for undergoing diagnosis reported for the 29 most recent diagnoses was hospital (45%), followed by private practice (34%) and CHC (21%).

Forty-eight participants (0.9%) reported a cough of >2 weeks (Table 1). Sputum samples were obtained from 38 (79%), and all had a negative smear result. Ten (21%) people were unable to provide sputum. All of those with TB symptoms, or who were unable to provide sputum, were followed up after 1 month; four reported continued coughing and provided a repeat sputum sample that again tested negative (Figure 2).

Intervention 2

From the CHC register, 40 TB index cases were identified, of whom 34 (85%) were contacted for screening of their household

TABLE 1 Intervention 1 households, eligible population and number with TB symptoms according to the randomly selected areas

Randomised area (RW)	Total households <i>n</i>	Total household members <i>n</i>	Eligible household members <i>n</i>	Previous TB diagnosis <i>n</i> (% of eligible)	Household members screened <i>n</i> (% of eligible)	TB symptoms <i>n</i> (% of household members screened)
Pasirwangi RW5	301	1345	1119	32 (2.9)	1117 (99.8)	17 (1.6)
Pasirjati RW7	311	1280	1027	14 (1.4)	1027 (100)	4 (0.4)
Pasangrahan RW5	328	1187	980	22 (2.2)	977 (99.7)	4 (0.4)
Cigending RW2	137	603	492	31 (6.3)	491 (99.8)	14 (2.9)
Pasir Endah RW3	460	1831	1488	45 (3.0)	1488 (100)	9 (0.6)
Total	1537	6246	5106	144 (2.8)	5100 (99.9)	48 (0.9)

RW = *rukun warga* (community associations); TB = tuberculosis.

members ($n = 88$), while 423 individuals were screened in neighbouring households (Figure 3). The mean age and sex among the household members and neighbours of index cases was respectively 35 years (range 11–73) and 36 years (range 10–76); respectively 50% and 48% were female. Six household contacts reported ever having had a TB diagnosis, of which one was in 2014–2015 (649 cases/100 000/year; 95%CI 16–36 179). In the neighbouring households, 16 people reported ever having had a TB diagnosis, of whom five had been diagnosed in 2014–2015 (675 cases/100 000/year; 95%CI 219–1576); two of these were diagnosed in hospital and three in private practice.

From the screening undertaken by the CHWs, four people reported TB symptoms and had their sputum tested, all of which were negative (Figure 3). Follow-up at 1 month revealed that one person in a neighbouring household still had a cough and had provided a second sputum specimen, which tested negative. Screening for each intervention took 3 months.

Focus group discussions

In the focus group discussions, we identified the benefits, barriers and enabling factors of the ACF programme. The key points identified are outlined in Table 2.

Benefits

The main benefit recognised by household members was easier access to sputum testing. For the CHWs, the recognised benefits

were increased knowledge about TB, better collaboration with the CHC staff and identifying other health conditions in their communities. The ACF programme also enabled CHC staff to see the potential of working with CHWs in meeting NTP targets and screening more people for TB.

This (ACF) was very useful. I only needed to provide the sputum then the CHW picked it up and delivered it. I just waited for the result. (Household member)

I learnt a lot about the people living around us and more 'socialised' with the people here. I can transfer my knowledge about TB to them and I know them better. (CHW)

This ACF gave insight to us that CHWs can be helpful to find TB patients. (CHC staff)

Barriers

The ACF programme was mostly appreciated by CHC staff, although it did create extra work and there was also concern over the quality of the sputum specimens received in the laboratory.

The sputum samples sent by CHWs are usually not in good quality... mostly saliva I guess. Also, I am working alone in the laboratory ... with no help. (Laboratory technician)

FIGURE 2 Flowchart of screening algorithm for Intervention 1. TB = tuberculosis. **FIGURE 3** Flowchart of screening algorithm for Intervention 2. TB = tuberculosis.

TABLE 2 Key issues identified from the ACF programme by CHC staff, CHWs and community members

	Benefits	Barriers	Supportive enabling factors
CHC staff	Increased TB programme coverage and meeting targets set by the NTP Enabled better collaboration and communication between CHC staff and CHWs	Increased workload for the CHC, especially laboratory staff, which was at times difficult to manage Concern about the quality of sputum specimens	CHC staff were able to see the potential of CHWs in TB prevention and control; with close supervision more active case finding could be undertaken
CHWs	The CHWs were able to gain good training in TB with knowledge they could pass on to their community The CHWs got to know their community better Increased status of the CHWs in the community	Embarrassment at reporting a cough Lack of trust in the CHWs because they are not trained nurses or doctors	Communities were welcoming towards the CHWs and because they were known in the community it was easier to approach individual households and community leaders Importance of having the support and supervision of staff in the CHC The structured approach to the ACF programme provided CHWs with some authority when going house-to-house The 'thank-you' gift was appreciated by households
Community members	Ease of access to information from CHWs and for sputum testing		Happy that they were visited by a CHW who was known to them

ACF = active case finding; CHC = community health clinic; CHW = community health workers; TB = tuberculosis; NTP = National TB Programme.

Using CHWs seemed to be accepted by the community, but for a few people this may have been seen as a barrier; in particular, there were concerns about the CHW not being a trained medical worker or embarrassment over admitting to a cough.

It is good that TB screening was done by CHWs from our neighbourhood. I already knew them well ... it facilitates the process. (Household member)

Sometimes people might have doubt about our capacity as CHWs because we don't have a medical background. (CHW)

Sometimes people seem shy to say that they have a cough ... I think the community is still afraid to be stigmatised if they were found to have TB. (TB nurse)

Enabling factors

The main factors recognised as important for ACF were CHW training, regular support and supervision and having a structured approach that gave the CHWs some authority in their communities.

In the field, as CHWs, we sometimes deal with stubborn people ... in this we need help or support from CHC. Together with TB nurse or doctor we can visit this stubborn patient. (CHW)

If we use CHWs for ACF, proper training about sputum collection should be established. (TB nurse in CHC)

Once the CHC nurse said to me that to find TB cases as CHWs we just need to do household visits. But, this approach is informal so we don't feel comfortable to ask people whether they have cough. Through this ACF we were trained and had the opportunity to do screening systematically and I feel honoured to do so. (CHW)

Cost analysis

The total estimated cost was US\$10 620 for Intervention 1 and US\$3231 for Intervention 2, with the main costs relating to the payment of personnel (Table 3). The cost per screened household member was respectively US\$2 and US\$6 for Intervention 1 and Intervention 2, while for those with TB symptoms, the cost was respectively US\$221 and US\$808.

DISCUSSION

From this feasibility study of household members in randomly selected communities, index case households and their neighbouring households, although we found only 1% with symptoms of cough and no confirmed TB cases by sputum smear testing, the ACF methods used were able to be carried out by the CHWs and were acceptable to the key stakeholder groups.

Nearly 100% of household members consented to screening, which is in keeping with a systematic review showing that most median consent rates were above 80%.² The simple, quick screening process, and the use of CHWs who were known to the community are likely to have contributed to the high consent rate. The CHWs were well respected in their communities, and involvement in the project gave them extra recognition as well as increased knowledge about TB. The CHWs were easily able to follow the algorithm and instructions for recording, and carried these out efficiently. Above all, they seemed to enjoy being involved and having the extra responsibility. Other studies have

TABLE 3 Cost of setting up and operating the ACF programme, in US\$*

Item	Intervention 1 n (%)	Intervention 2 n (%)
Recurrent costs, US\$		
Personnel	7 598.52 (71.5)	2 473.94 (76.6)
Supplies	1 399.85 (13.2)	140.26 (4.3)
Others	658.32 (6.2)	347.40 (10.8)
Sub-total	9 656.69	2 961.60
Capital costs		
Training	963.64 (9.1)	269.82 (8.3)
Sub-total	963.64	269.82
Total cost	10 620.33 (100)	3 231.42 (100)
Cost per screened household member	2.08	6.30
Cost per household member with TB symptoms	221.26	807.85

*US \$1.00 = Indonesian rupiah 13 389.41
ACF = active case finding; TB = tuberculosis.

also shown the benefit of using a well-functioning network of CHWs.^{18,19} The CHWs need to have a structured system combined with good supervision and collaboration with CHC health staff; involvement on the part of the established CHC staff was therefore vital. Counting TB cases alone does not capture the indirect effects of ACF, such as the additional TB knowledge gained by the CHWs, the TB knowledge passed on to household residents and the cases that might be reported passively in the future.

It was unusual that no TB cases were found from our reasonably large sample, and that only 1% of individuals reported having a cough. There are several possible explanations for this. First, some individuals reported being embarrassed at having a cough and having to report it to a CHW. Second, while we opted for a simple screening algorithm that was easy to use by the CHWs and that operated within the current NTP guidelines, by doing so we may have missed those who are bacteriologically positive but do not report classic symptoms (estimated in the prevalence survey to be 42.5% of TB cases when using chest X-ray).¹⁰ Third, while most of those with cough were able to provide sputum for smear microscopy, the samples provided may not have been of good quality, despite the training provided.²⁰ We did, however, follow up those with negative results, most of whom had become asymptomatic; four individuals with ongoing symptoms again tested negative. The high estimated incidence of previously diagnosed TB cases in neighbouring households vs. community households (675 vs. 325 per year/100 000) suggests that TB cases come from high-risk neighbourhoods, and this is certainly worthy of further study.

While we were unable to perform a formal cost-effectiveness analysis in our study due to the lack of confirmed TB cases, we were able to show that for a relatively small amount of money a large number of individuals could undergo simple symptom screening. While the addition of other diagnostic tests to the screening algorithm would obviously increase the cost, they should be considered for any future ACF programme in Indonesia.

Our randomisation clusters were fairly homogeneous in terms of age and sex, and the selection process maximised the chances of representing the Ujung Berung catchment population, which is fairly representative of Bandung City. Our study did not have any comparison control areas, and this would need to be considered for a large intervention trial. No external quality control of the laboratory sputum testing facility was carried out during the study, but quality assurance is regularly undertaken with the Provincial Reference Laboratory.

CONCLUSIONS AND RECOMMENDATIONS

Our feasibility study showed that house-to-house screening can be performed using CHWs and that a larger effectiveness study is indicated, focusing on neighbourhoods of known TB cases as well as the TB index case households themselves. Furthermore, the use of CHWs to conduct the screening can be integrated into routine

practice in CHCs with relative ease. Better access to, and use of, improved diagnostics, especially chest X-ray, would be an important consideration in any future ACF programmes.

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Contexte : Une zone de desserte d'un centre de santé communautaire dans la partie est de la ville de Bandung, Indonésie.

Objectif : Evaluer la faisabilité de deux différentes interventions de dépistage recourant à des travailleurs de santé communautaire (CHW) dans la détection des cas de la tuberculose (TB).

Schéma : Une étude de faisabilité : 1) du dépistage des symptômes de TB en porte à porte dans cinq quartiers sélectionnés au hasard dans la zone de desserte, et 2) recherche des contacts familiaux des patients TB index et leur voisinage. L'acceptabilité a été évaluée grâce à des groupes focaux avec les partenaires clés.

Résultats : Sur 5100 individus dépistés dans des quartiers sélectionnés au hasard, 48 (0,9%) ont rapporté des symptômes, dont

38 ont fourni des crachats : aucune TB n'a été découverte. Aucun cas de TB n'a été trouvé parmi les 88 contacts familiaux ni parmi les 423 personnes du voisinage. Avec une formation, un soutien régulier et une supervision par le personnel de recherche et le personnel du centre de santé communautaire local, les CHW pourraient efficacement entreprendre le dépistage, et presque tous les habitants ont accepté de participer.

Conclusion : Le recours aux CHW pour le dépistage de la TB pourrait assez facilement être intégré dans la pratique de routine en Indonésie. L'efficacité de cette stratégie mériterait d'être explorée davantage, en particulier en recourant à des outils diagnostiques améliorés comme une radiographie pulmonaire et une culture de crachats.

Marco de referencia: La zona de influencia de un consultorio comunitario en la parte oriental de la ciudad de Bandung, en Indonesia.

Objetivo: Evaluar la factibilidad de dos intervenciones diferentes de detección sistemática practicadas por los agentes de salud comunitarios (CHW) en la búsqueda de casos de tuberculosis (TB).

Método: Se llevó a cabo un estudio de factibilidad que examinó: 1) la detección sistemática de los síntomas de TB, de puerta a puerta, en cinco barrios de la zona de influencia escogidos de manera aleatoria y 2) la investigación de contactos de los casos nuevos de TB en sus hogares y en el vecindario. Se organizaron grupos de opinión con interesados directos clave a fin de evaluar la factibilidad de la intervención.

Resultados: De las 5100 personas participantes en los vecindarios escogidos, 48 refirieron síntomas (0,9%) y 38 aportaron muestras de esputo, de las cuales ninguna fue positiva para TB. No se detectaron casos de TB en los 88 hogares de los contactos ni en los 423 contactos del vecindario. Con la capacitación, el apoyo periódico y la supervisión por parte del grupo de investigación y del personal de salud del centro comunitario local, los CHW emprendieron de manera eficaz una detección sistemática y casi todos los miembros de los hogares aceptaron participar.

Conclusión: La participación de los CHW en la detección sistemática de la TB se puede integrar sin dificultad en la práctica corriente en Indonesia. Se precisa un examen más detenido de la eficacia práctica de esta medida, en especial con la utilización de métodos diagnósticos mejorados como la radiografía de tórax y el cultivo de muestras de esputo.