



# Additional active tuberculosis cases detected and costs incurred by a second household contact investigation

O. Myint,<sup>1,2</sup> H. Sriplung,<sup>2</sup> C. C. San,<sup>3</sup> V. Chongsuvivatwong<sup>2</sup>

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In routine contact investigation in Myanmar, basic health staff conduct home visits and symptom screening among household contacts before investigation. We supplemented this with follow-up telephone calls by programme nurses inviting all contacts to be screened. The staff identified 376 contacts, 4 with symptoms, 3 of whom presented, including 1 with tuberculosis (TB). Due to the second intervention, 264 of the remaining 373 contacts received screening and 17 additional cases were detected. The additional cost incurred by the second intervention was 4.3 times higher than that of the conventional method, but TB yield was increased by a factor of 17.

In Myanmar, household contact tracing for tuberculosis (TB) is currently implemented by the Basic Health Staff (BHS) who visit the households of index patients. However, the diagnostic yield of new cases is only about 1% (unpublished data, 2016 National Tuberculosis Programme [NTP]). The present study was conducted to document the additional yield and costs resulting from inviting all household contacts for screening at the TB centre.

## METHODS

### Setting

The study was conducted in Patheingyi township, capital of the Ayeyarwady Region, Myanmar, a country with a high TB burden (incidence: 358 per 100 000 population).<sup>1</sup> Approximately 80% of the households in the Ayeyarwady Region have mobile phones.<sup>2</sup> The city has a total population of 287 071, 59.1% of whom are urban. In 2016, the case notification rate for all forms and for bacteriologically confirmed TB was respectively 346 and 153/100 000.<sup>3</sup>

### Study design

This was a special intervention study where, in accordance with national guidelines, household contact management was performed initially using routine methods involving home visits by BHS, which were followed up by telephone calls by programme nurses. The study was conducted between November 2018 and January 2019.

### Conventional method of contact management

The BHS visit households of index patients and assess their household contacts for TB symptoms. Contacts with symptoms are then referred to the TB centre for

sputum microscopy and chest X-ray (CXR). Only BHS are provided a travel allowance. No transportation costs are offered to contacts. All other clinical investigations are provided free of charge.

### Study intervention

Index patients were contacted by telephone by programme nurses and asked to bring their contacts to the centre to undergo sputum microscopy free of charge, and Xpert® MTB/RIF (Cepheid, Sunnyvale, CA, USA) testing if they were CXR-positive.

### Estimation of facility/service cost

The unit cost for household contact investigations involving both methods was obtained from the NTP. The nurse was reimbursed for the cost of the telephone call and given an incentive of US\$2.29 per index case. The laboratory and X-ray technicians were reimbursed US\$0.65 and the radiologist was reimbursed US\$1.31 per contact investigated as compensation of extra workload. Household contacts were reimbursed US\$1.31 for travel expenses in the intervention.

### Ethics approval

The proposal was approved by the Human Research Ethics Committee of the Faculty of Medicine, Prince of Songkla University, Hat Yai, Thailand (REC Number: 61-235-18-1) and the Ethics Review Committee of the Department of Medical Research, Yangon, Myanmar (ERC no Ethics/DMR/2018/127).

## RESULTS

A total of 376 household contacts of 128 consenting index cases were identified by the BHS (Figure). Approximately 55% of the home visits were confirmed by the index patients in a subsequent interview. Four contacts had TB symptoms, three of whom presented, which yielded one bacteriologically confirmed case. Of the remaining 373 contacts, follow-up telephone calls and arrangement by the nurses resulted in 111 index cases bringing in 264 for investigation. This yielded four extra bacteriologically confirmed and 13 clinically diagnosed cases. TB yield among household contacts screened was 0.3% based on the conventional method, and 6.4% based on the additional intervention.

The Table compares the costs of the two methods. Personnel costs comprised US\$418.56 for the BHS and US\$293.12 for programme nurses. The total cost of the investigation as a result of the second intervention was US\$1197.69, in addition to US\$3.03, which is the

### AFFILIATIONS

- 1 Department of Public Health, Patheingyi, Ayeyarwady Region, Myanmar
- 2 Epidemiology Unit, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla, Thailand
- 3 National Tuberculosis Programme, Ministry of Health and Sports, Nay Pyi Taw Union Territory, Myanmar

### CORRESPONDENCE

Virasakdi Chongsuvivatwong  
Epidemiology Unit  
Faculty of Medicine  
Prince of Songkla University  
15 Kanjanavanich Road  
Hat Yai  
Songkhla 90110 Thailand  
email: cvirasak@medicine.psu.ac.th

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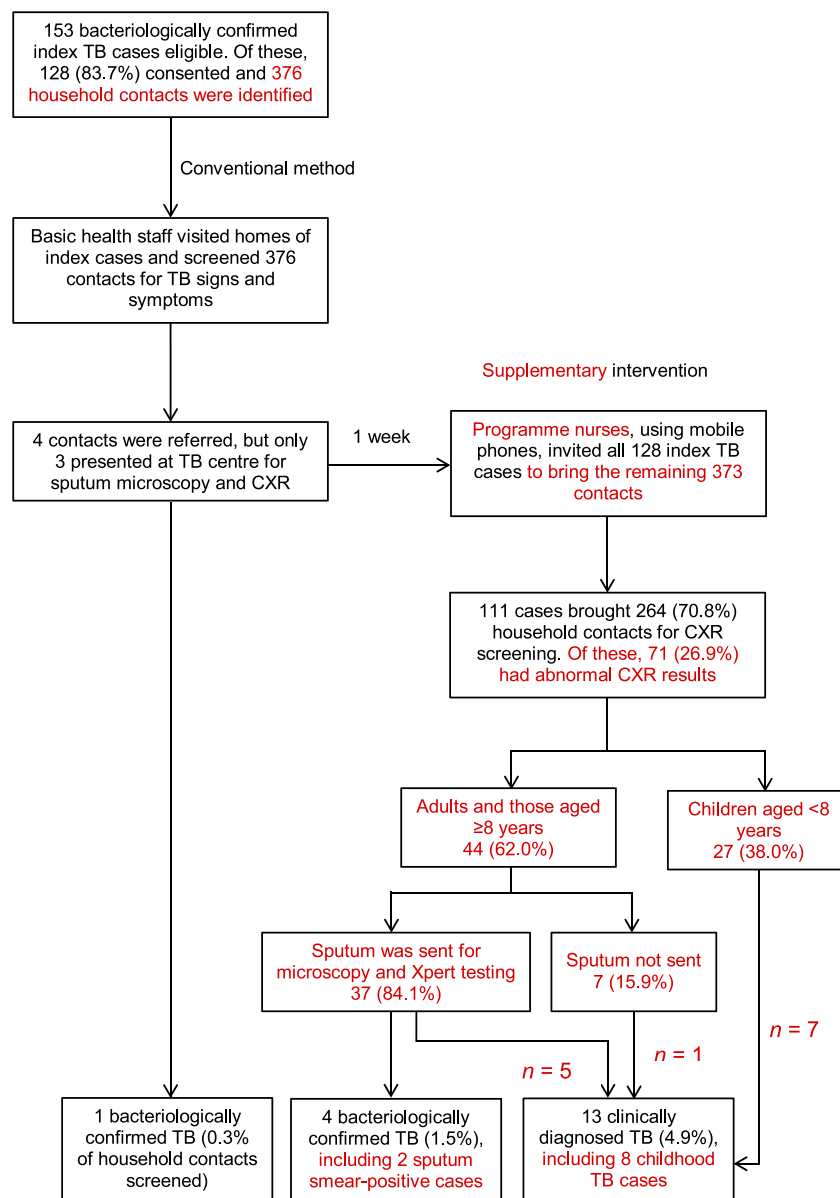
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### KEY WORDS

household contact; TB; adherence; yield; cost

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**FIGURE** Flow diagram showing the recruitment of participants and the yield for new active TB. TB = tuberculosis; CXR = chest X-ray.

cost of implementing the conventional method. Based on the original intervention, travel costs for household contacts was US\$345.84. The total cost after including the costs of the supplementary intervention was US\$2255.21 in addition to US\$421.59 when using the conventional method alone. The incremental cost-effectiveness of the intervention was thus:  $(US\$2255.21 - US\$421.59)/(18 - 1) = US\$107.86$  for each extra case detected.

## DISCUSSION

The study revealed that the conventional household contact investigation was ineffective. Our study intervention was more cost-effective and yielded an additional 17 TB cases among 264 household contacts screened.

The diagnostic yield of the intervention was 6.4%, compared to only 0.3% by the conventional method. The Myanmar NTP

does not generally perform routine verification of BHS's home visits. Only 55% of homes were confirmed to have been visited by the BHS based on patient interviews in this study. The BHS used symptom screening, although it is well known that symptoms have low sensitivity.<sup>4</sup> If all the household contacts visited by the BHS were invited to undergo CXR regardless of existence or absence of symptoms, more cases would be detected.

The final yield for active disease among household contacts investigated in this study was comparable to the yield in Uganda (6%),<sup>5</sup> but lower than a previous study in Myanmar (13.8%),<sup>6</sup> and higher than the global average of 3.1%.<sup>7</sup> This variation in prevalence was too high to be explained by differences in TB prevalence in the population, and is more likely to have been due to a difference in the quality of work among the officers responsible and of the techniques used. In this study, some cases may have been due to clinical overdiagnosis, which is particularly likely

**TABLE** Comparison of costs between the conventional method and the additional intervention in the household contact investigation of 128 index cases

Items	Conventional method			Second intervention		
	<i>n</i>	Unit cost (\$US)	Total cost (\$US)*	<i>n</i>	Unit cost (\$US)	Total cost (\$US)*
Personnel costs						
Basic Health Staff (travel costs)	128	3.27/index	418.56	128	3.27/index	418.56
Programme nurses (telephone bill and compensation)	†	†	†	128	2.29/index	293.12
Travel cost						
Household contacts	†	†	†	264	1.31/contact	345.84
Investigation costs						
				3	0.69/contact	2.07
CXR	3	0.69/contact	2.07	264	2.65/contact‡	699.60
				3	0.32/contact	0.96
Sputum microscopy	3	0.32/contact	0.96	37	0.98/contact§	36.26
Xpert MTB/RIF assay	†	†	†	37	12.40/contact	458.80
Subtotal	†	†	3.03	†	†	1197.69
Total costs		†	421.59		†	2255.21
Incremental cost	†	†	†	†	†	1833.62

\*Total cost = unit cost multiplied by number of index cases who participated/contacts investigated.

†Not estimated.

‡Cost for CXR: material cost + reimbursement for extra workload of CXR technicians and radiologist.

§Cost for sputum microscopy: material cost + reimbursement for extra workload of laboratory technicians.

CXR = chest X-ray.

among child contacts; however, a large proportion of TB in high-burden settings could be due to recent transmission and a high TB burden is common among infants and children.<sup>8</sup> Moreover, the majority of the contacts with abnormal CXR had no chronic cough and could not produce quality sputum, leading to TB-negative results despite the use of Xpert testing. However, the final diagnosis was based consensus among clinic doctors, senior officers and radiologists.

The incremental cost-effectiveness ratio in this study was US\$107.86 per additional active case detected. As this is below the 2017 Myanmar gross domestic product per capita of US\$1256, the intervention may be considered cost-effective. A previous study conducted in Myanmar also reported the cost-effectiveness of an interventional model using initial CXR compared to the modified conventional method, at US\$35.41 per additional case detected.<sup>9</sup> The addition of household contact investigation to an existing passive case finding programme in Africa was also reported as being cost-effective at US\$443.62 per additional case detected.<sup>10</sup>

The study findings indicate that the addition of follow-up telephone calls to households of index cases and subsequent screening with CXR and Xpert testing was cost-effective. These two methods should replace symptom screening used by the BHS regardless of whether or not the intervention strategy is adopted.

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Dans la recherche de routine des contacts au Myanmar, le personnel de santé de base fait des visites à domicile et du dépistage de symptômes parmi les contacts familiaux avant l'investigation. Nous avons complété cette méthode avec un suivi par téléphone par les infirmiers du programme invitant tous les contacts à se faire dépister. Le personnel a identifié 376 contacts,

dont 4 avaient des symptômes, 3 se sont présentés et 1 avait une tuberculose. Grâce à cet initiative complémentaire, 264 des 373 contacts restants ont été dépistés et 17 cas supplémentaires ont été détectés. Le coût additionnel lié à cette intervention supplémentaire a multiplié par 4,3 celui de la méthode conventionnelle mais le rendement a été multiplié par 17.

En la investigación corriente de los contactos de pacientes con tuberculosis (TB) en Myanmar, los trabajadores de salud básica visitan los hogares y realizan el tamizaje de síntomas en los contactos domiciliarios antes de remitirlos para investigación. Este método se complementó con llamadas telefónicas de seguimiento por parte de personal de enfermería del programa, que invitaban a todos los contactos a participar en la detección sistemática. Con la

investigación corriente se encontraron 376 contactos, cuatro presentaban síntomas y en tres de ellos se diagnosticó la TB. Al poner en práctica la iniciativa complementaria, se practicó la detección sistemática a 264 de los 373 contactos restantes y se diagnosticaron otros 17 casos de TB. El costo de la intervención adicional fue 4,3 veces más alto que el costo del método habitual, pero el rendimiento diagnóstico se multiplicó por 17.