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COUNTING THE COSTS: A REVIEW OF TWO TUBERCULOSIS MASS CONTACT SCREENING INVESTIGATIONS

Cait Lonie, Michael Levy, Michael Frommer

INTRODUCTION

Methods to control the spread of tuberculosis include effective treatment of active cases and screening for infection[1]. Mass screening of the community with annual chest x-rays was a major component of the Australian Tuberculosis Campaign between 1948 and 1976[2]. This campaign was ceased in 1979 following marked decreases in the prevalence of tuberculosis.

As the positive predictive value of the screening tests is greater in groups with a higher prevalence of disease[3], screening for tuberculosis in Australia is now targeted at high-risk groups to increase the benefits. The contacts of active cases are one such group, especially where there is an elevated risk of disease transmission, e.g. the closest contacts of active cases. However, sometimes screening of contacts with a lower risk may be undertaken, e.g. screening contacts at worksites. This article reviews the costs and benefits of contact screening which was carried out at two worksites.

METHODS OF THE CONTACT INVESTIGATIONS

The index cases will be called Case A and Case B, and their worksites Site A and Site B respectively.

Case A was highly infectious with evidence of transmission to family contacts, who required chemoprophylaxis. By contrast, Case B was only mildly to moderately infectious, and there was no evidence of transmission to close contacts. In both investigations the index case had worked on a number of shifts and in different places at the site.

While it was impossible to determine the degree of workers' contact with the index cases, all workers who had been potentially exposed to the index cases (by virtue of having been employed at either site) were screened. This included workers who had subsequently left (retired, resigned or taken a transfer) between the time of exposure and the surveys.

Workers from Site A and Site B were offered screening at the workplace, and those who had left either site were contacted by letter requesting that they attend their local chest clinic for screening. The screening at Site A took place within weeks of the diagnosis of the index case, while at Site B there was a 10-month delay. To protect the index case's identity, all employees at both worksites were included in the screening, and no attempt was made to assess the risk of exposure among the potential contacts in relation to their work location.

Of the 273 workers employed at Site A at the time of the survey, 243 were screened at the workplace with a mobile chest x-ray and

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Correspondence

Please address all correspondence and potential contributions to:

The Editor,
NSW Public Health Bulletin,
Public Health Division,
NSW Health Department
Locked Bag No 961,
North Sydney NSW 2059
Telephone: (02) 391 9218
Facsimile: (02) 391 9232

TABLE 1

COMPARISON OF SCREENING AT TWO WORK SITES

	Site A	Site B
Date of diagnosis of index case	September 1991	April 1991
Date of screen at work site	September 1991	February 1992
Degree of index case infectivity+	High	Low-moderate
Transmission to close contacts	Yes	No
Total number of people screened from workplace	273	441
Number of retirees/transferees for screening	Included above	105
Mean age (years)	40.7	37.3
Number (%) born overseas	167 (62%)	283 (64%)
Number (%) born in South-East Asia	80 (30%)	176 (40%)
Screening tests used	Mantoux test Chest x-ray	Chest x-ray
Total number with abnormalities	30 (11%)	23 (5%)
Number of abnormalities on chest x-ray alone	22 (8%)	23 (5%)
Tuberculous abnormalities detected		
Transmitted cases	0	0
Active cases	0	1
Inactive cases	3	1
Conditions detected requiring other referral	4	1
Definite abnormalities on x-ray, but did not attend for follow-up	*	4/23 (17%)
Technical fault, but did not attend for follow-up	*	9/23 (39%)
Number requiring ongoing review in chest clinics	6	6
Costs	$6,697	$4,783**

+ Degree of infectivity is based on evidence of transmission to others, length of illness and direct smear positivity.

* Not available.

** Does not include the cost of following up transferees and retirees.

Tuberculosis screening

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Mantoux test. The remaining 30 workers were absent at the screening times, and they attended the local Chest Clinic. A total of 441 Site B workers was screened at the workplace with a mobile chest x-ray (but not a Mantoux test), and 105 workers who had left site B were invited to attend local chest clinics.

Any workers with abnormalities consistent with tuberculosis infection requiring further investigation were referred to a local Chest Clinic. The indications for referral and further investigation depended on the clinical interpretation of the test results and clinical policies in each Chest Clinic. People with abnormalities not consistent with tuberculous infection were referred to their general practitioner for further investigation and treatment.

Data from each investigation were collected from Chest Clinics and entered onto an EPI_INFO database for analysis. Chest Clinic staff, including nurses, physicians and technical assistants, were interviewed.

Costs were approximated from Medicare schedules[4], from NSW Health Department figures[5] and calculated from approximate costs supplied by Chest Clinic staff.

RESULTS FROM THE INVESTIGATIONS

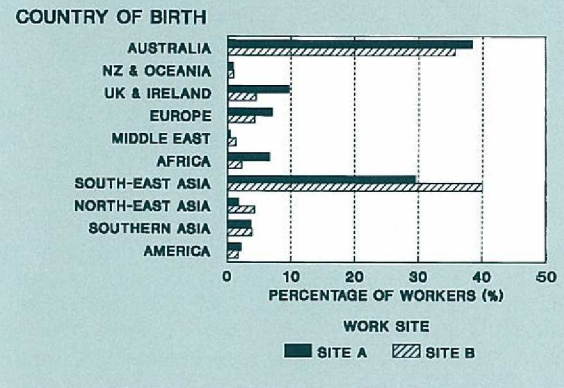
The conduct and results of the investigations are summarised in Table 1. The workers were predominantly male, with a high proportion of workers born overseas, particularly South-East Asia (see Figure 1).

Site A

Most workers at Site A were screened with a chest x-ray

FIGURE 1

COUNTRY OF BIRTH IN EMPLOYEES SCREENED FOR TUBERCULOSIS, SITE A COMPARED TO SITE B



and a Mantoux test. Two hundred and twenty-nine contacts (84 per cent) had Mantoux tests, the results of which were read for 226. One hundred and one (44 per cent) of these were negative (<5mm). Of the 115 contacts with positive Mantoux results 106 (92 per cent) had a history of BCG vaccination, two had not had a BCG, and in seven the BCG status was not known. Of these last two groups, eight had normal x-rays so they required ongoing review and one had an abnormal chest x-ray which required a clinic visit and ongoing review at Chest Clinics.

Of the chest x-rays, abnormalities were detected in 22 (8 per cent) of the contacts. Three of these were considered to be normal on second reading. The other 19 required a larger film. These contacts were discharged as normal (six) or with inactive TB (three), or referred to their general practitioner

with incidental findings (four), and six required ongoing review.

Site B

Workers at Site B were screened with a chest x-ray only. Twenty-three (5 per cent) of the x-rays of staff at Site B were read as abnormal and were referred to the Chest Clinic closest to their place of residence. These contacts either failed to attend for follow-up (four), were discharged as normal (12), required ongoing review (four), diagnosed with an incidental finding (one) or diagnosed with active TB (one). This last contact was a 27-year-old Vietnamese Chinese woman who had a positive Mantoux test and a chest x-ray consistent with tuberculosis. Although she denied other contacts with tuberculosis, her physician believed the disease was probably not a result of transmission from the index case because of the degree of contact with the index case and her ethnic background.

There were 23 contacts at Site B who had technical faults with their chest x-rays and were asked to attend their local chest clinic for a repeat chest x-ray. These contacts either failed to attend for follow-up (nine), were discharged as normal (seven), had inactive TB (one), required ongoing review (one) or were lost to follow-up (five).

COSTS OF THE SCREENING INVESTIGATIONS

The direct costs of the investigations include the cost of the mobile van, staff time at Chest Clinics and at the site, and the tests required. The indirect costs include the loss of the workers' time, and the opportunity costs for the resources used: Chest Clinic Nurses, radiographers, consultants and the mobile van. Intangible costs would include the anxiety caused by false positive abnormalities found on the screen, or by the identification of asymptomatic underlying or unrelated disease.

An estimate of the direct costs is presented in Table 2. The cost at Site A was approximately $6,700 ($24.53 for each person screened), and for Site B $4,800 ($8.76 per person). These figures are underestimates because indirect or intangible costs are not included.

Costs at Site A were higher as a nurse was required for three days to give and read the Mantoux tests. Costs at Site B may be lower than expected because of the large number of people who did not attend for further investigation after abnormalities or faults with their x-rays.

DISCUSSION

This review highlights many of the problems encountered during mass screening for tuberculosis infection. Both the Mantoux test and the chest x-ray lose sensitivity and specificity for tuberculosis infection when the prevalence of the infection in the population being screened decreases. This is reflected in an increase in the number of people with false positives that require further investigation and ongoing review for periods up to one year. This may amount to a considerable intangible cost for those affected.

A large percentage of contacts at each site were lost to follow-up. Many of these were contacts who were not in close touch with the index case, and because of the nature of their work could not return to have their Mantoux test read. Once the decision to screen contacts is made, it is essential that they are followed up, otherwise the reasons for screening these contacts must be questioned.

In this review, the contacts born in Asia were three times more likely to have a positive Mantoux test than workers born in Australia ($X2=47.7$, $p<0.001$), and three of the contacts (75 per cent) with inactive tuberculosis came from Asian countries. At worksites where there is a high proportion of workers born overseas, this will result in a high rate of false positives (i.e. Mantoux positives due to previous exposure or BCG vaccination). Unless this can be effectively managed in the protocols used to screen overseas-born contacts, the costs for screening are increased.

TABLE 2

COST ESTIMATES FOR THE SCREENING OF THE TWO WORK SITES

	Site A	Site B
On-site costs	$1,443	$1,802
Personnel costs	$2,070	$ 947
First follow-up at clinic	$2,798	$1,712
Second follow-up at clinic	$ 386	$ 322
TOTAL	$6,697	$4,783

Although screening for tuberculosis has traditionally been used for the control of tuberculosis, it is most effective when it is targeted at high-risk populations. Screening of contacts with less exposure may be ineffective and very costly. The NSW Health Department is addressing these issues by encouraging a risk assessment approach for contacts, so the highest risk contacts are screened first, and only if there is evidence of transmission in this group would screening be conducted in any lower risk contacts.

At the time of this review there were no standardised Health Department policies on mass contact screening. These principles are outlined in a strategy for the control of tuberculosis in NSW[6]. This is an important element in addressing the continuing problem of tuberculosis infection in our community.

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