Effectiveness of tuberculosis contact tracing among migrants and the foreign-born population

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A literature review was performed to assess the effectiveness of tuberculosis (TB) contact tracing among migrants and the foreign-born population with emphasis on the European Union. Effectiveness of contact tracing was assessed using the following indicators: coverage, proportion of contacts with TB (TB yield), proportion of contacts with latent tuberculosis infection (LTBI yield) and number of investigated contacts per index case (contacts/index case ratio). The key findings from the literature review were: Among foreign-born contacts, a higher median LTBI yield was found compared with contacts born in the country, when exposed to the same foreign-born index cases. No clear differences were observed between TB and LTBI yield among contacts of foreign-born index cases compared with contacts of index cases from the general population (including the foreign-born) due to the large variation seen between the studies. The included non-European studies screened more contacts per foreign-born index case, used lower cut-off values to define a positive tuberculosis skin test and found higher LTBI yields among contacts. Although the high heterogeneity across the studies made the comparison challenging, several conclusions are made regarding contact tracing among migrants.

Introduction

Contact tracing is regarded as an effective strategy to identify recently infected individuals and has become an essential component of the tuberculosis (TB) control strategy in most low-incidence countries [1-4].

In most European countries, migrants and foreign-born account for a large proportion of TB patients, ranging from 9% to 76% [5]. Their risk of infection and progression to disease might differ from the local-born population (for the purpose of this paper, the term 'local-born' will be used in the sense of 'born in the country') due to increased exposure to TB in their country of origin [6]. Diagnostic results may need to be interpreted differently among migrants due to the high level of people in this group who are vaccinated with Bacillus Calmette-Guérin (BCG) and to the high prevalence of latent tuberculosis infection (LTBI) [6]. Some countries with a high prevalence of tuberculosis also have a high prevalence of human immunodeficiency virus (HIV) and high co-infection rates. Diagnosis of both latent TB infection and active TB are more complicated in this population. Particularly, interpretation of the results of the tuberculosis skin test (TST) is often made difficult due to the high number of false negative results.

Regardless of the strategy used to detect TB and LTBI among migrants, it needs to be effective in the group that is targeted. Underwood et al. compared contact tracing with new entrant screening in East London and concluded that contact tracing was more effective in detecting and preventing tuberculosis than new entrant screening, mainly because contact tracing selects for families or communities at particularly high risk [7].

The above issues need careful evaluation when performing contact tracing among the migrants and foreign-born.

Contact tracing in general serves different purposes [4]:

- Identifying individuals with TB disease or LTBI among the contacts of a TB patient and providing adequate treatment or follow-up;
- Reducing morbidity and mortality due to TB among newly infected individuals;
- Reducing further transmission.
- The objective of this review is to assess the effectiveness of TB contact tracing among migrants and the foreign-born population, hereafter referred to as foreign-born, with emphasis on the European Union (EU).

Methods

Literature search

The online reference databases PubMed and Cochrane were searched using keywords combinations of TUBERCUL(OSIS) and IMMIGRANT(S) (or MIGRANT(S) or ASYLUM SEEKER(S) or REFUGEE(S) or FOREIGN-BORN or NEW ENTRANTS) and CONTACT (TRACING or INVESTIGATION or EXAMINATION). The search was limited to publications in English from the last 10 years. Additional references were obtained via the reference lists of the articles found through the search engines. Articles published up to June 2008 were included. Titles and abstracts were screened to sort the relevant papers from the non-relevant ones. Abstracts and where available full text of relevant papers were thoroughly screened and classified as A, B, C or D:

A: Randomised comparative research, where intervention and control are randomly assigned to receive a certain screening programme/test;

B: Studies reporting yield and/or coverage of contact tracing among the foreign-born by any given strategy (i.e. stone-in-the-pond principle, workplace contacts only) or any given method (chest X-ray (CXR), tuberculin skin test (TST), interferon gamma release assays (IGRA), symptom screening);

C: Studies reporting on contact tracing among the foreign-born but not reporting yield or coverage data;

D: Studies discussing policies and strategies of contact tracing at country or regional level in relation to public health/epidemiology as well as studies on the cost-effectiveness of contact tracing. Studies that reported contact tracing but did not relate to foreign-born people were also included in this group.

This classification was adapted for contact tracing studies from the classification used by Klinkenberg et al. for studies into the effectiveness of TB screening strategies for migrants [8].

Data Extraction

A datasheet was designed to extract data from articles classified A and B. We did not attempt to obtain original data. Articles classified C and D were used for discussion of the findings. In some studies, no differentiation was made between foreign-born and local-born index cases and therefore the term "index cases from the general population" was used.

Definitions

Index case: the initial patient diagnosed with TB.

Contact: a person who may have been exposed to the index case during the infectious phase.

LTBI yield: the proportion of LTBI cases detected among the total number of fully investigated contacts.

TB yield: the proportion of TB cases detected among the total number of fully investigated contacts.

Coverage: the proportion of investigated contacts (for LTBI) relative to the total number of listed contacts.

Contacts/index case ratio: the number of fully investigated contacts (for LTBI and TB) per index case.

LTBI treatment rate: the proportion of infected contacts that started LTBI treatment relative to the total number of eligible infected contacts.

LTBI treatment completion rate: proportion of contacts that completed LTBI treatment relative to the total number of infected contacts that started LTBI treatment.

Stone-in-the-pond or ring principle: a strategy wherein contacts are indentified in concentric circles around the index case, depending on the frequency and intimacy of their contact [9].

Definitions for the expressions *migrant, asylum seeker, foreign-born and illegal migrant* were adapted from Rieder *et al*. [10].

Definitions of closeness of contacts where adapted from Kamphorst *et al.* [4].

Effectiveness of contact tracing

The following indicators, based on recommendations by the United States Centers for Disease Control and Prevention (CDC) in 2005, were used to assess the effectiveness of contact tracing [11]: coverage, TB yield, LTBI yield and contacts/index case ratio. The higher the values of these indicators, the more effective they were considered to be. For the sake of consistency the different indicators were recalculated where possible using the same definition across all studies.

Because the strategy and the context of contact tracing across the studies differed considerably (depending on setting, infectiousness of the index case, media interest etc.), five analytical approaches were identified and followed:

1. Assessment of studies describing contact tracing for one foreign-born index case.
2. Assessment of studies reporting pooled results of smaller contact investigations exercises. For these studies, outcomes for foreign-born index cases were compared with outcomes for index cases from the general population (including foreign-born index cases) to assess differences in outcomes.
3. Assessment of differences in transmission of TB infection from foreign-born index cases to foreign-born contacts and local-born contacts.
4. Evaluation of whether the closeness of contacts affected the effectiveness of contact tracing.
5. Comparison between European and non-European studies with regards to the effectiveness of contact tracing.

Because only few studies reported yield among contacts by sputum status of the index case, data were not sufficient to present stratified results for this.

The results of three contact investigations described by Kim et al. were pooled to be included under approach 2, as all three were large scale investigations in a similar setting using a comparable strategy [12].

Results

Literature search

A total of 112 (non-duplicate) references were found using the search terms. A further six studies were found via the references of relevant articles. In addition, one study was found when PubMed was searched for studies not written in English, making it a total of 119 studies. After thorough screening of abstract and, where available, full paper, 70 papers were considered relevant and given a classification of A, B, C or D. No papers were classified as category A. Eighteen papers were classified B, of which six were from EU countries [13-18] and twelve from non-EU countries [12,19-29]. Table 1 provides an overview of the key parameters extracted from the eighteen B-classified studies.

Contact tracing strategies

No uniform contact tracing strategy was used across the selected studies. In six studies, the stone-in-the-pond principle was used

Table 1

Overview of contacts/index case ratio, coverage, TB yield and LTBI yield reported in the 18 B-classified studies

Parameter	Proportion (interquartile range) [range]
No. of papers	18
Contacts/index case ratio	7.5 (4.4–71.5) [3.0–475]
Coverage	73.5% (39.3–82.3) [29.1–93.3]
TB yield	0.44% (0.00–2.15) [0.00–14.08]
LTBI yield	31.9% (16.9–36.9) [0.0–44.4]
LTBI treatment started	83.1% (72.9–94.6) [69.1–100]
LTBI treatment completed	63.6% (56.4–67.2) [43.5–78.6]

[14,16-19,21]. In three studies, only workplace contacts were investigated. In the study by Gulati et al., the workplace contact investigation consisted of four components [22]: 1) interview with the index case; 2) a qualitative evaluation of the buildings and their ventilation systems; 3) screening of the co-workers; and 4) interviews with co-workers. The other two studies focused on workplace contacts because the index cases were foreign-born healthcare workers [13,26]. In two studies, only close contacts were screened [24,27] and in one study only household contacts [20]. In the remaining six studies, the contact tracing strategy was not clearly described, mainly because these were retrospective studies that used pooled data of various contact investigations.

With regard to the five analytical approaches described in the methods section, the following was found:

1. Studies with one index case of active tuberculosis

Five studies reported contact tracing activities around one foreign-born index case (Table 2). The median TB yield reported was 0.0% (interquartile range (IQR) 0.0–3.52). The median LTBI yield reported was 28.9% (IQR 12.7–37.1). A median of 89.2% (IQR 81.3–94.8) of the eligible LTBI identified contacts started preventive treatment, of whom a median of 66.7% (IQR 55.1–72.6) completed the preventive treatment.

2. Studies with pooled results of contact investigations

In Table 3, studies with pooled results of different contact investigations are presented.

TB yields among contacts of exclusively foreign-born index cases were in the same range as among contacts of index cases from the general population (median TB yield of 0.63% (IQR 0.5–1.3%) versus 0.46% (IQR 0.0–2.2%)) The median LTBI yield seemed slightly higher among contacts of foreign-born index cases compared with contacts of index cases from the general population, being 39.1% (IQR 20.6–43.7%) and 33.7% (IQR 28.5–36.2%), respectively.

3. Foreign-born and local-born contacts from the same index case

Four studies reported separately on LTBI (but not TB disease) detected among foreign-born contacts and local-born contacts, with both groups exposed to the same foreign-born index cases (Table 4). The LTBI yield among foreign-born contacts was notably higher than among local-born contacts (median 48.9% versus 12.1%) except in one study: Verver et al. reported a slightly higher LTBI yield among local-born contacts than among foreign-born contacts [17]. The contacts/index case ratio found in foreign-born contacts and local-born contacts in these studies was similar (medians of 44.0 and 43.0, respectively).

4. Yield in close contacts and non-close contacts

The effect of closeness of contacts was assessed by comparing findings among close and non-close contacts from foreign-born index cases and index cases from the general population (Table 5).

The results indicate a slightly higher median LTBI yield in close contacts of foreign-born index cases than of index cases from the general population (median 43.7% and 37.0%, respectively), although the interquartile ranges are overlapping. In non-close contacts, the median LTBI yield is higher among contacts of index cases from the general population than among contacts of foreign-born index cases (median 29.0% versus 15.4%). However, the

Table 2

Variables of effectiveness in studies reporting contact tracing in studies with one foreign-born index case

Country	Country/region of origin index case	Contacts/ index case ratio (n)	Coverage (%)	TB yield (%)	LTBI yield (%)	Study
The Netherlands	Algeria	n.r.	n.r.	0.00	12.7[a]	[18]
United States	The Philippines	475	29.1	0.00	5.3[b]	[26]
United States	n.r. (foreign-born)	63	n.r.	14.1	44.4[b]	[25]
United States	El Salvador	97	93.3	n.r.	37.1[b]	[22]
United States	Central America	218	82.6	0.00	28.9[b]	[23]
-	-	157.5 (88.5–282.3)	82.6 (55.9–87.9)	0.0 (0.0–3.52)	28.9 (12.7–37.1)	Median (IQR)

IQR= interquartile range; n.r.= not reported.
[a] TST+ was defined as an induration of >10 mm; [b] TST+ was defined as an induration of ≥5 mm.
Note: In one of the five studies, TB yield was not reported as the paper focused on risk factors for LTBI. In three studies, no contacts with TB were detected [18,23,26]. The fourth study found 10 cases among 71 contacts [25].

Table 3

Median with interquartile range of effectiveness indicators for studies with pooled results of contact investigations

No. of studies	Median proportion of index cases that are foreign-born	Contacts/index case ratio (n)	Coverage (%)	TB yield (%)	LTBI yield (%)	References
6	100%	5.7 (4.8–12.3)	79.7 (76.0-81.9)	0.63 (0.48-1.31)	39.1 (20.6-43.7)	[12,14,17,19,21,24]
9	56.0 (51.5-60.0)	5.1 (4.1-6.9)	79.2 (75.3-83.1)	0.46 (0.04-2.15)	33.7 (28.5-36.2)	[13,15,16,20,21,24,27-29]

interquartile ranges are similar. The large difference reported in the contacts/index case ratio between non-close contacts of foreign-born index cases and those derived from index cases from the general population (48.0 and 2.6, respectively) is due to the fact that the data for the first group were mainly obtained in studies reporting on one large contact investigation. The high contacts/index case ratio may also explain the lower LTBI yield found in non-close contacts of foreign-born index cases.

Interestingly, the median TB yield found among close contacts of index cases from the general population was higher than among close contacts of foreign-born index cases (median 2.2% and 0.0%, respectively). However, results should be interpreted with care as only three studies were available of which two had a TB yield of 0.0%. The close contacts included local-born individuals as well as foreign-born individuals, although it is reasonable to assume that a higher proportion of close contacts of foreign-born index cases were themselves foreign-born (e.g. household contacts).

5. EU studies versus non-EU studies

Three EU studies and eight non-EU studies were found which reported specifically on contact tracing among foreign-born index cases. Five of the non-EU studies were reports of a single large contact investigation, which explains the high contacts/index case ratio. In the EU-studies a median LTBI yield of 11.6% (IQR 11.1–12.2%) was found; in non-EU studies it was 38.1% (IQR 26.8–43.9%). This large difference in LTBI yield is likely to be (at least partly) due to the lower TST cut-off values used in the non-EU studies (i.e. a positive TST defined as an induration of ≥5mm). The median TB yield was comparable between EU studies (0.44%, IQR 0.2–1.5%) and non-EU studies (0.60%, IQR 0.0–1.1%).

6. Sputum smear status of the index case

Sixteen of the 18 studies included in this review reported sputum smear status of the index case. However, only six of them compared outcomes by sputum smear status [15-17,24,27,29]. For these, a higher LTBI yield was found among contacts of sputum smear-positive index cases than among smear-negative index cases. An interesting difference regarding smear status was reported by Golub *et al.* [24]. Among contacts of sputum smear-positive index cases, similar LTBI rates were found in contacts of foreign-born and local-born index cases (46% and 43%, respectively). However, for sputum smear-negative index cases there was a difference. Among the contacts of local-born index cases, only 15% were infected, compared to 44% among the contacts of foreign-born index cases.

Discussion

The main findings resulting from this literature review were:

- When exposed to the same foreign-born index cases, a higher median LTBI yield was found among foreign-born contacts compared to local-born contacts.
- Large variation was seen between studies and no differences were observed between TB or LTBI yield among contacts of foreign-born index cases compared with contacts of index cases from the general population (including the foreign-born).

Table 4

The transmission of LTBI: foreign-born index cases to foreign-born contacts and foreign-born index cases to local-born contacts*

Transmission: foreign-born index cases to foreign-born contacts		Transmission: foreign-born index cases to local-born/low prevalence		Study
Contacts/index case ratio (n)	LTBI yield (%)	Contacts/index case ratio (n)	LTBI yield (%)	
2.0	9.7[a]	0.9	12.6	[17]
52.0	67.3[b]	25	44.0	[25]
36.0	80.6[b]	61	11.5	[22]
82.0	30.5[b]	124	8.9	[12]
44.0 (27.5–59.5)	48.9 (25.3–70.6)	43.0 (19.0–76.8)	12.1 (10.8–20.5)	Median (IQR)

IQR=interquartile range.
* The results in both parts of the table are from the same studies; [a] TST+ was defined as an induration of ≥10 mm for non BCG-vaccinated children and an induration of ≥16 mm for BCG-vaccinated children; [b] TST+ was defined as an induration of ≥5 mm; [c] TST+ was defined as an induration of >10 mm.

Table 5

Median with interquartile range of effectiveness indicators for contact tracing in close contacts and non-close contacts in foreign-born index cases and index cases of the general population

Group	No. of studies	Contacts/index case ratio (n)	Coverage (%)	TB yield (%)	LTBI yield (%)	References
Foreign-born index cases						
with close contacts	6	5.8 (5.4–12.8)	88.0 (86.3-91.1)	0.00 (0.00-0.77)	43.7 (25.5-48.9)	[12,17-19,23,24]
with non-close contacts	4	48.0 (5.5-93.4)	71.8 (70.8-83.8)	Insufficient data	15.4 (9.4-22.5)	[12,17,19,23]
General population index cases						
with close contacts	7	3.8 (3.2-5.1)	82.1 (80.3-84.2)	2.15 (2.07-2.28)	37.0 (32.9-40.2)	[15,16,20,21,24,27,29]
with non-close contacts	4	2.6 (1.8-4.1)	n.a.	0.40 (0.20-1.80)	29.0 (14.5-29.7)	[13,15,16,21]

n.a.=not applicable

- In non-EU studies, more contacts per foreign-born index case were screened, lower TST cut-off values were used to define a positive TST, and higher LTBI yields were found.

Of the nine studies with pooled results of contact investigations, three studies reported remarkably higher TB yields than the rest [16,24,27]. The study by Solsona *et al*. was conducted in the inner city district of Barcelona, where high risk groups (HIV-infected individuals, drug users, immigrants and homeless) represent a large proportion of the population [16]. In these high risk groups, higher TB rates can be expected regardless of recent infection. In the studies by Golub *et al*. and Marks *et al*., only close contacts were included and a high proportion of the contacts were foreign-born, which might explain the high TB yield found [24,27]. However, Soren *et al.* also included only close contacts, but found no active TB cases among 659 contacts investigated [20]. The study by Anderson *et al*. did not detect LTBI in any of the contacts, possibly due to underreporting and/or incomplete test results [13].

The high TB and LTBI yield found in the study by Dewan et al., a study with one foreign-born index case, might be due to transmission by another adult with TB living at the same place as the presumed index case [25]. The high number (n=475) of contacts screened per index case in the CDC study is likely related to the fact that the index case worked in the newborn nursery and maternity ward and therefore large scale contact tracing was conducted [26].

Limitations of the study

Although the focus of this study was on the effectiveness of contact tracing among the foreign-born population in EU countries, only six relevant EU studies were found from which data could be extracted. This highlights the lack of reported evidence from EU countries and indicates that more data reports are needed. The collection and reporting of data showed a high level of heterogeneity across the studies, which made the results difficult to compare and no firm conclusions could be drawn. For instance different cut-off values for a positive TST were used, i.e. ≥5mm and ≥10mm. In addition, some studies used adapted cut-off values for TST testing in BCG-vaccinated individuals [17,28] whereas others did not [25]. Not all studies mentioned if and how persons with prior positive TST results were included. Slightly different definitions were used across the studies, for instance for close and non-close contacts. In the included studies among contacts of the index cases from the general population, close contacts included more often only household contacts than in studies reporting contacts of foreign-born index cases, which more often included workplace contacts. The broader definition used by the latter studies could explain why they found a lower TB yield among contacts in this groups because of less proximity to the index case. The characteristics of the index cases differed in terms of sputum and culture status. Not all studies accounted for or reported people lost to follow-up, and the duration of contact tracing differed between studies. Some studies used a three months follow-up period, while others used a few years.

Challenges of contact tracing among foreign-born individuals

Sputum smear status of the index case

As mentioned, only six studies compared outcomes by sputum smear status. As expected, a higher LTBI yield was found among contacts of smear-positive cases compared to contacts of smear-negative patients. The yield was almost three-fold higher in foreign-born contacts.

It should be noted that this higher yield among foreign-born contacts could be due to the higher background rate of LTBI in this part of the population who acquired infection in their country of origin. It is evident that if this hypothesis holds true, contact tracing in this group of individuals should possibly be considered as a form of screening to identify latent infections not related to the index case

Standardisation of methods used to diagnose TB and LTBI in contacts

In the studies included that reported TB yield, a large variety of methods was used to detect TB. While the gold standard to detect TB disease is a positive culture of Mycobacterium tuberculosis, not all studies used this. Most studies used CXR in combination with symptom screening. In most studies, CXR was used after a positive TST was found.

For many years, LTBI has been identified using the TST. Despite its widespread use, the TST has proved to be less specific among individuals born in high-incidence countries due to cross-reaction with the BCG vaccine (see below) and with atypical mycobacteria, both of which are present in individuals from high-incidence countries [30]. In some studies, CXR was used besides the TST to assess infection. Langenskiold *et al*. and MacIntyre *et al*., for example, used both TST and CXR to define LTBI [15,28]. CXR was also used to find evidence of prior TB.

Recently, interferon gamma release assays (IGRAs) have become commercially available for the detection of LTBI. These tests have characteristics that seem to make them more suitable for screening among migrants: they do not cross-react with BCG vaccination and less frequently with atypical mycobacteria [31,32], and they seem to give a better indication of the time of infection [4]. However, there is a need to asses if the test is equally effective in people from high- versus low-incidence countries [33].

BCG vaccination status

Only four of 18 studies provided information on BCG vaccination status. This is a major drawback, as most foreign-born index cases and foreign-born contacts described in this study were from countries with a high TB incidence that have high BCG vaccination rates. Because of the possible cross-reaction induced by BCG, LTBI yield among foreign-born contacts needs to be interpreted with care for the studies that did not adjust the TST cut-off values for BCG-vaccination status, since the number of cases may have been overestimated due to false positives.

DNA fingerprinting and epidemiological linkage

The assumption underlying contact tracing is that contacts have been infected by the index case around whom the investigation is centred. However, it has been demonstrated through DNA fingerprinting that contacts can be infected by another strain of *M. tuberculosis* than the one that infected the presumed index case [21,34]. Identical DNA fingerprints between contact and index case suggest that transmission has occurred [35]. Thus, not all contacts have been infected by the presumed index case, but some have been infected by another source. Genetic characterisation of the pathogen can therefore have important implications for source finding.

In most low-incidence countries, foreign-born cases have a lower rate of clustering than local-born cases [36,37]. This is often interpreted to mean that foreign-born people develop TB as a consequence of reactivation of prior infection, the likelihood of which is related to country of origin, age at migration, socio-demographic factors, and duration of stay in the new country [5]. Moreover, a foreign-born person could have been recently infected or reinfected when visiting their country of origin, rather than by

transmission from the source case [5]. Similarly, clustering among local-born people could be due to specific sociological factors.

These findings suggest that the use of molecular typing and cluster analysis in support of traditional contact tracing should be further explored.

Stigma of TB and fear of naming contacts

Social stigma is recognised as an important barrier for successful care of people affected by TB [38]. Stigma might also prevent foreign-born index cases from naming (all of) their contacts. Fear might play a significant role in naming contacts when these are staying illegally in the country of residence. The number of exposed contacts can therefore be underreported, which can result in a bias. However, few data are available on the effect of stigma in contact tracing.

Treatment compliance

Only eight of the studies reviewed here reported the proportion of contacts who started LTBI treatment and only six studies reported treatment completion rates. These limited results did not indicate a difference in adherence between foreign-born contacts and contacts from the general population (including foreign-born). The overall adherence was 63.6%, suggesting preventive treatment can be effective. However, the benefits of treatment should be carefully balanced against the side effects such as drug-induced hepatitis [3] as well as against treating people unlikely to develop TB.

Cost-effectiveness of contact tracing

Although this was not the scope of this literature review, research indicated that contact tracing was highly cost-effective and resulted in net savings [39]. Dasgupta *et al*. reported that close-contact investigation was more cost-effective than screening of immigration applicants and surveillance programmes [39]. The latter two ways of case detection were less cost-effective largely because of substantial operational problems such as additional visits for education and reassurance, evaluation of side effects or new medical problems, or assistance with social problems, all of which are common in newly arrived immigrants.

Conclusions

From this review several conclusions can be drawn to address the challenges facing contact tracing among migrants.

Uniform contact tracing strategy

According to this study and that done by the Tuberculosis Network European Trials Group (TBNET) [40] a high variety of contact tracing strategies are being applied across and even within countries. Not every contact investigation can reasonably be conducted with the same strategy, uniform decisions about who needs to be assessed and why a certain strategy has been chosen should be agreed upon. It is therefore important to get more insight in decision making policies. Key questions to be answered are for example: which considerations are made to decide the initial size of the contact investigation? When do local health services expand the contact investigation to the next circle of contacts? Who is responsible for that decision?

Uniform data collection and reporting

To compare the effectiveness of the different contact tracing strategies used, data need to be collected and reported more uniformly. Definitions should be used uniformly throughout studies to be able to better compare results. Usage of standardised protocols might help to achieve this. International validated cut-off values are needed to define a positive TST induration, and these should be adjusted for BCG-vaccination status.

Contact tracing as a screening strategy

The findings emphasise that foreign-born people from high-incidence countries are at high risk of acquiring or having LTBI. Contact tracing could be used as a screening strategy to identify cases in a high-prevalence population and could be seen as a 'high-risk screening' exercise [7].

Targeted screening

The objective of contact tracing is to find individuals recently infected with TB who are likely to develop active disease. Those at high risk of developing active TB need to be better targeted.

There is an urgent need for a diagnostic tool to identify people with recent latent infection that are at highest risk for developing active disease. This is especially relevant among foreign-born contacts due to the challenge of interpreting the currently available tests due to, for example, BCG, HIV status, nontuberculous mycobacteria and background TB prevalence. Additional research is needed to verify whether the promising IGRAs are reliable in detecting recent infection and are suitable for use in the migrant population.

In conclusion, it should be noted that finding of higher LTBI yields in contact investigations among foreign-born contacts is not unexpected given higher background infection prevalence in these populations. Identifying for which infected contacts close follow-up or preventive treatment should be offered remains a priority. This will be key in determining the role of extensive contact tracing in the context of enhanced TB control among high-risk populations and in establishing its cost-effectiveness.

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