

# The Yield of Tuberculosis Screening of Undocumented Migrants from the Horn of Africa based on Chest Radiography

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**ABSTRACT:** **Background:** Since 2006 more than 60,000 migrants arrived in Israel from the Horn of Africa (HoA: Sudan, Eritrea, Ethiopia). They were detained in prison and screened for tuberculosis (TB) by means of an interview and chest X-ray (CXR).

**Objectives:** To evaluate the yield of this screening process.

**Methods:** This cross-sectional study evaluated the validity of CXR in a random sample of 1087 of the 5335 HoA migrants (20.4%) who arrived in 2009, and assessed its related costs.

**Results:** Sixty-two migrants (5.7%) had CXRs with TB-suspicious findings, and 11 of them were finally diagnosed with TB (17.7% of all TB-suspicious CXRs). TB point-prevalence was 1000 cases per 100,000 migrants (1.0%). As no additional TB cases were diagnosed on arrival, CXR sensitivity, specificity and positive predictive value were 100%, 96.1% and 17.7%, respectively. The interview did not contribute to the detection of migrants with TB. Direct costs related to the detection of single TB cases in prison was 17,970 shekels (US\$ 4585), lower than the treating cost of 28,745 shekels (\$ 7335). During 2008–2010, 88 HoA migrants who had been screened at the prison after crossing the border were later diagnosed with TB in the community. The average annual TB incidence was 132 cases/100,000 migrants. We traced 56 (63.6%) of the CXRs that were performed during detention. Of those, 41 (73.2%) were unremarkable, 8 (14.2%) were TB suspicious and 7 (12.5%) had non-TB-related abnormalities.

**Conclusions:** CXR-based screening is a valid and cost-saving tool for screening HoA migrants for TB; the interview has significant limitations.

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**KEY WORDS:** chest X-ray (CXR), immigration, Horn of Africa (HoA), Israel, screening, tuberculosis (TB)

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The movement of individuals across international borders has increased in recent decades. Migration movement from developing to developed countries poses the potential risk of *Mycobacterium tuberculosis* transmission from the migrants to fellow migrants and the local population in the host countries. The number of tuberculosis (TB) cases reported in Israel has decreased since the late 1990s, while the number of unregistered migrants with notified TB is steadily increasing. The 1999–2010 annual average incidence of TB among Israeli-born and undocumented migrants was 0.86 and 27 per 100,000 population, respectively [1]. A new wave of migration, including more than 60,000 unregistered (undocumented) migrants, has arrived illegally in Israel from the Horn of Africa (HoA, namely Sudan, Eritrea and Ethiopia). Since they did not possess valid border-crossing documents upon entry, these migrants were incarcerated in a temporary detention center. During imprisonment, they were screened for TB by a short interview focusing on TB-related symptoms, and by chest X-ray (CXR) in postero-anterior and lateral aspects; the CXRs were read by radiologists. Migrants who responded positively to questions regarding TB-related symptoms (cough, weight loss, chest pain, fever), or whose CXR demonstrated radiological findings suggestive of TB, were referred to a single TB clinic for further evaluation, which included medical checkup and sputum analysis for smear microscopy and culture. Migrants who were diagnosed with TB were treated using directly observed therapy while in incarceration and were discharged to the community only after completion of the treatment regimen.

The migrant screening program in Israel is CXR based [2], despite the controversy raised in developed countries regarding its cost-effectiveness and debates on its relative benefit as compared to a medical interview [3]. This cross-sectional study

**Table 1.** Characteristics of a sample of 1087 undocumented migrants from the Horn of Africa screened at the Israeli border in 2009, by chest X-ray findings and tuberculosis diagnosis

		CXR with findings suspicious of TB (n=62)		
		TB diagnosis (n=11)	TB ruled out (n=51)	P value
Male:Female ratio		10:1	3.9:1	< 0.01
Age (years ± SD)		36.1 ± 10.7	35.2 ± 12.1	0.8
Country/area of birth	Eritrea	5 (45.4%)	36 (70.6%)	0.1
	Sudan	5 (45.4%)	21 (41.2%)	1.0
	Ethiopia	1 (9.2%)	4 (6.7%)	0.8
Questions asked in the interview	Current smoking	3 (27.3%)	27 (52.9%)	0.1
	Previous TB treatment	2 (18.2%)	7 (13.7%)	0.6
	Cough > 2 weeks	3 (27.3%)	14 (27.4%)	0.4
	Weight loss	1 (9.2%)	2 (3.9%)	0.4
	Fever	2 (18.2%)	5 (9.8%)	0.6
	Night sweats	1 (9.2%)	2 (3.9%)	1.0
	Human immunodeficiency virus	1 (9.2%)	3 (5.9%)	0.5

CXR = chest X-ray, TB = tuberculosis, SD = standard deviation

evaluated the validity of CXR and assessed its related costs in detecting TB among undocumented migrants from the HoA.

## SUBJECTS AND METHODS

Undocumented migrants from the HoA were randomly selected by the Israeli Prison Services to be radiographed in one of two medical centers to which they are contracted. Of the 5335 migrants who crossed the southern Israeli border illegally and were detained during 2009, 1087 (20.4%) underwent CXR at a single institution.

TB was defined if the subject was symptomatic and had confirmed *M. tuberculosis* complex culture, or when the physician prescribed a full course of anti-TB therapy due to symptoms and radiological findings [4,5]. Radiological findings suggestive of TB comprised at least one of the following: middle/upper lobe infiltrates, bronchopneumonia, cavitations, consolidation and hilar/intrathoracic lymphadenopathy, apical fibrosis or fibrotic scar, pleural thickening/plaques, or the radiologist's comment "suspected TB" [6]. CXR was classified as normal if there was no evidence of pathology pertaining to TB.

This study describes the TB burden among migrants from the HoA at two levels. The first constitutes the results of the screening performed in the prison, generating point-prevalence. The second includes a follow-up period of 3 years, identifying African migrants who developed TB in the community after being discharged from prison, generating commutative incidence. Their medical records and CXR were located and reevaluated. The Institutional Review Boards of Ben-Gurion

University and the Israel Defense Forces approved this study.

Comparisons between categorical and continuous variables were performed by the chi-square and Student's *t*-test, respectively, using SPSS (17.0 version, Chicago, IL, USA). Validity of the CXRs was expressed by sensitivity, specificity and positive predictive values (PPV), while active TB detection was considered the end-point.

## RESULTS

The random sample of this study included 1087 undocumented migrants, of whom 641 (59.0%) were Eritreans, 280 (25.7%) Sudanese and 166 (15.3%) Ethiopians. The male:female ratio of the entire sample was 8.1:1 and their average age was 34.8 ± 17.2 years. All were interviewed and radiographed. Sixty-two (5.7%) of the CXRs demonstrated radiological findings suggestive of TB; these individuals were referred to the TB clinic, where 11 were finally diagnosed as having TB (17.7% of all suspicious CXRs). TB point-prevalence on arrival was 1000 cases per 100,000 migrants (1.0%). Since no additional cases were diagnosed from this cohort during the detention period, CXR sensitivity, specificity and PPV were 100%, 96.1% and 17.7% respectively.

TB patients were more likely to be males. They responded negatively to most of the items on the questionnaire in the interview [Table 1]. Of the 11 individuals diagnosed with TB, 10 (90.9%) had pulmonary TB and 1 (9.1%) had extra-pulmonary TB. Sputum smear-positive results were recorded in 3 (27.3%), and positive culture in 8 (72.7%). All 8 cultures were sensitive for first-line drugs, while 3 (37.5%) were streptomycin resistant.

The detection of 11 TB patients required 1078 CXRs and 62 TB clinic evaluations, at direct costs of 98 and 1434 shekels (NIS) (US\$ 25 and 367) each, respectively, accumulating in NIS 17,970 (\$ 4585) to detect one TB patient. Conversely, the cost for treating a single TB patient in Israel is ~ NIS 28,700 (\$ 7335).

During the 3 years of follow-up between 1 January 2008 and 31 December 2010, 88 migrants from the HoA were diagnosed with TB in the community after being discharged from detention where they had undergone TB screening. The community of HoA migrants in Israel was estimated at ~30,000 in 2010, and in 2008–2010 the average annual incidence was 132 cases for 100,000 such migrants. Most (n=59, 67.0%) were diagnosed with pulmonary TB and 29 (33.0%) had extra-pulmonary TB. Their average age was 28.6 ± 8.5 years; 55 (62.5%) were Eritreans, 24 were Sudanese (27.3%), and 9 were Ethiopians (10.2%). The male:female ratio was 10:1 and 7 (7.9%) were co-infected with human immunodeficiency virus.

We traced 56 (63.6%) of the CXRs that were performed during the detention of these 88 migrants who were later diagnosed with TB in the community. Of these 56 CXRs, 41 (73.2%) were unremarkable, 8 (14.2%) showed radiological findings suggestive of TB, and 7 (12.5%) had non-TB-related abnormalities.

## DISCUSSION

The CXR-based screening strategy for TB among undocumented migrants was a valid and cost-saving tool. In contrast, the interview has significant limitations. These migrants continue to develop TB in the community, possibly due to recent infection or reactivation of a latent TB infection.

The sensitivity of CXR in our study was high, comparable with a similar Swiss study that described asylum seekers, mostly from the HoA, who were screened at the Swiss border [7], and lower than the 80.1% of the legal Ethiopian migrants screened in Israel [8]. The interview, which failed to identify most of the migrants who were diagnosed with TB, is considered a low sensitivity instrument [7,9] due to linguistic barriers and possible reporting bias, since incarcerated migrants may respond in a way that they believe would hasten their discharge. Due to the relatively short duration of detention, i.e., a few months, it is essential that the screening instrument be sensitive enough to identify all TB suspects. Early diagnosis during incarceration is critical because an inmate who develops TB in prison may infect other inmates [10]. Additionally, undocumented migrants who are discharged from prison and develop TB in the community may delay treatment due to the unlawful nature of their stay and the lack of previous experience with the Israeli medical system, being unaware that TB treatment is free and not related to deportation. The use of interpreters in prison to translate the medical interview and explain the importance of the TB symptoms questionnaire may increase its sensitivity.

Despite rigorous screening efforts, undocumented migrants were diagnosed in the community, suggesting latent TB reactivation, recent transmission, or inadequate screening. These young migrants from the Horn of Africa, who survived a long and arduous journey to Israel, may enjoy the “healthy migrant effect” – namely, better health condition. However, this effect may be weakened due to injuries that occurred during the journey, overcrowded housing, poverty, and constant tension due to the threat of deportation [11], and lessens with time. In addition, CXR screening may miss migrants who have latent TB infections that may reactivate at a later stage. Lastly, it is also possible that due to the high volume of CXRs performed for screening in prison, radiologists may fail to diagnose CXR findings suggestive of TB.

In order to reduce community transmission, undocumented migrants should be educated to recognize TB-related symptoms and also informed of the location of the community TB clinic. Additionally, they should be informed that TB treatment in Israel is free and not connected to the legality of their stay. Financial incentives for periodic testing of these migrants in the community might also reduce diagnostic delay.

This report has several limitations. First, only the questionnaires of confirmed TB cases were traced; the questionnaires from the entire cohort could not be found. Second, only ~70%

of the CXRs of the migrants diagnosed in the community could be located because of technical factors. Nonetheless, it is unlikely that excluding these patients resulted in selection bias, since omissions were due to technical reasons and probably unrelated to potential clinical characteristics. Third, the small number of TB patients who were diagnosed with TB limits comparisons. Lastly, CXR is not indicated for detecting cases of extra-pulmonary TB, although it is less prioritized in terms of public health concerns.

In conclusion, CXR-based screening is a valid and cost-saving tool for TB screening of undocumented migrants from the Horn of Africa. The interview, however, has significant limitations.

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### References

- Mor Z, Pinsker G, Cedar N, Lidji M, Grotto I. Adult tuberculosis in Israel and migration: trends and challenges between 1999 and 2010. *Int J Tuberc Lung Dis* 2012; 16 (12): 1613-18.
- Mor Z, Lerman Y, Leventhal A. Evaluating tuberculosis pre-immigration process in Ethiopian immigrants to Israel. *Eur Respir J* 2008; 32 (2): 413-18.
- Iademarco M, O'Grady J, Lönnroth K. Chest radiography for tuberculosis screening is back on the agenda. *Int J Tuberc Lung Dis* 2012; 16 (11): 1421-2.
- World Health Organization. Treatment of Tuberculosis: Guidelines. 4th edn. Geneva: WHO/HTM/TB/2009/420, 2010.
- Veen J, Raviglione M, Rieder HL, et al. Standardized tuberculosis treatment outcome monitoring in Europe. Recommendations of a Working Group of the World Health Organization (WHO) and the European Region of the International Union Against Tuberculosis and Lung Disease (IUATLD) for uniform reporting cohort analysis of treatment outcome in tuberculosis patients. *Eur Respir J* 1998; 12 (2): 505-10.
- Diagnostic standards and classification of tuberculosis in adults and children. The American Thoracic Society Official Statement. *Am J Respir Crit Care Med* 2000; 161 (4): 1376-85.
- Schneeberger G, Helbling P, Zelweger JP, et al. Screening for tuberculosis in asylum seekers: comparison of chest radiography with an interview-based system. *Int J Tuberc Lung Dis* 2010; 14 (11): 1388-94.
- Mor Z, Leventhal A, Weiler-Ravell D, et al. Chest radiography validity in screening pulmonary tuberculosis in immigrants from a high-burden country. *Respir Care* 2012; 57 (7): 1137-44.
- Hoa NB, Cobelens FGJ, Sy DN, et al. Yield of interview screening and chest X-ray abnormalities in a tuberculosis prevalence survey. *Int J Tuberc Lung Dis* 2012; 16 (6): 762-7.
- Mor Z, Adler A, Leventhal A, Volovic I, et al. Tuberculosis behind bars in Israel: policy making within a dynamic situation. *IMAJ* 2008; 10: 202-6.
- Tafari S, Martinelli D, Melpignano L, et al. Tuberculosis screening in migrants reception centers: results of a 2009 Italian survey. *Am J Infect Control* 2011; 39: 495-9.
- Nesher L, Riesenber K, Saidel-Odes L, Schlaeffer F, Smolyakov R. Tuberculosis in African refugees from the sub-Saharan region. *IMAJ* 2012; 14: 111-14.