Tuberculosis diagnostic delay and therapy outcomes of non-national migrants in Tel Aviv, 1998-2008

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Non-national migrants have limited access to medical therapy. This study compares diagnostic delay and treatment outcomes of non-insured non-national migrants (NINNM) with insured Israeli citizens (IC) in the Tel Aviv tuberculosis (TB) clinic between 1998 and 2008. Patient delay was the time from symptoms onset to doctor's visit, while system delay was measured from doctor visit to anti-TB therapy administration. We randomly sampled 222 NINNM and 265 IC. NINNM were younger than IC, had lower male to female ratio and fewer smoked. They had less drug/alcohol abuse, more cavitations on chest radiography, longer patient and shorter system delay. Mean patient and system delays of all patients were 25 ± 14 and 79 ± 42 days, respectively. In multivariate analysis, being NINNM, asymptomatic or smoking predicted longer patient delay, while being asymptomatic or having additional co-morbidity predicted longer system delay. Treatment success in sputum smear-positive pulmonary TB NINNM was 81% and 95.7% in IC ($p=0.01$). Treatment success was not associated with patient or system delay. In multivariate analysis, work security and treatment adherence predicted treatment success. NINNM had longer patient delay and worse therapy outcome, while IC had longer system delay. Both delays should be reduced. NINNM should be informed that TB therapy is free and unlinked with deportation.

Introduction

The global movement of people from less-resourced countries to more affluent and industrialised countries seeking work and improved living conditions has increased during the last decades [1]. Health authorities in many countries of destination are concerned with the potential importation of tuberculosis (TB) by migrants who originate in high TB prevalence areas [2], as it is estimated that about one third of them are infected with *Mycobacterium tuberculosis*, and approximately 5 to 10% of those infected will eventually develop active TB [3].

Undocumented migrants in the United States (US) and Europe are usually not medically insured and are most likely excluded from health services [4, 5]. Nevertheless, most industrialised countries cover TB treatment costs for all non-national migrants (NNM), mainly to protect the citizens in the hosting countries from infection [6]. This approach is also being practiced in Israel, which has become a selected destination for labor migration since the early 1990ies.

Israel is a country of around eight million inhabitants, and it is estimated that 226,000 NNM presently stay in the country. The majority originate from low-resourced countries, characterised by a high TB burden [7]. Of all 6.2 million Jews living in Israel in 2011, 1.9 (30.1%) were born outside Israel. Unlike NNM, Jewish newcomers to Israel are naturalised upon arrival and are never refused nor delayed, regardless of their health status, age, education or sex. They are also entitled to a comprehensive package of social, educational and financial benefits, including medical insurance from day one of their arrival, in order to accelerate their absorption into society. The policy of encouraging the migration of individuals of Jewish decent is one of the core values of the Israeli society, who is keen to assimilate the newcomers [8].

Most NNM live in Tel Aviv, which is the largest metropolis of Israel (1.3 million inhabitants), and functions as the commercial, cultural and social center for all NNM communities in Israel.

Documented NNM who hold a valid working visa are medically insured by their employer in private medical insurances as long as they are employed. Regretfully, in many instances when a NNM is diagnosed with TB, they lose their jobs, and the medical insurance companies tend to refrain from covering medical expenses, claiming that TB is an exacerbation of a prevailing medical condition. Undocumented NNM, who account for around half of all migrant workers in Israel, are not

medically insured. The Israeli Ministry of Health reimburses TB clinics for treating both documented and undocumented NNM. In order to reduce barriers to medical treatment, therapy at the TB clinics is free and confidential, and patients are not reported to the immigration authorities or to their employers.

Diagnostic delay, comprised of patient and system delays, is an important determinant in TB control. Long diagnostic delay was found in Italy and Spain to result in more severe presentation and extensive disease, as well as an increased likelihood of TB transmission and elevated reproductive rate of TB in the community [9,10]. The aim of our study was to assess factors associated with diagnostic delay, and to compare diagnostic delay and treatment success between non-insured NNM (NINNM) and that of Israeli citizens (IC) in the Tel Aviv lung clinic. Our hypotheses was that NINNM will have longer diagnostic delays and worse treatment outcomes than IC, as they may not have access to most of the ambulatory services, and in addition they may (wrongly) perceive that their illness might be used by their employer to discharge them or lead to deportation.

Methods

In our retrospective study we compared a random sample of NINNM and IC who were older than 18 years of age and were treated in the Tel Aviv TB outpatient clinic for active TB between 1998 and 2008. The catchment area of the TB clinic includes Tel Aviv and central Israel, with a population of about two million people.

IC were either Israeli-born or born elsewhere and naturalised. Patients were excluded from the study if they were naturalised during the TB-treatment, and if they started or completed their treatment in another TB clinic.

Definitions used

A TB case was defined as a patient with pulmonary or extrapulmonary TB diagnosed by a pulmonologist specialised in TB, on the basis of clinical symptoms, and who additionally (i) had either direct sputum smear microscopy or culture positive for *M. tuberculosis*, and/or (ii) was prescribed a full course of anti-TB drugs for a period longer than three months due to TB-related symptoms, or due to chest radiography findings.

Outcome variables were diagnostic delay, namely patient and system delay, as well as treatment success. Patient delay was defined as the time elapsed from the estimated date of onset of symptoms, as reported by the patients, to the first time they attended medical care with regard to those symptoms. System delay was defined as the time elapsed from the first medical visit with regard to the TB symptoms until initiation of anti-TB therapy. Patient or system delays were categorised as 'long' if they were greater than the mean delay of all patients sampled. Treatment success was defined as patients who were cured or completed therapy, as

classified by the World Health Organization (WHO) guidelines [11].

Independent variables for diagnostic delay and treatment success included sex, country of birth, citizenship, length of stay in Israel, TB site, smoking, drug or alcohol use, employment status, human immunodeficiency virus (HIV) infection, any underlying chronic disease, and sputum smear, culture and drug susceptibility results.

Continuous variables were presented by means and standard deviations (SD). Comparisons between groups were made using the chi-square or Fisher's exact test for categorical variables and Student's *t*-test for continuous attributes distributed normally or the Mann-Whitney test for variables whose distribution was not normal. All *p*-values reported are based on two-tailed comparisons with statistical significance set at $p < 0.05$. Variables which were found significant in the bivariate analysis, and after assessing for collinearity, were entered the multivariate analysis performed by the logistic regression model. The statistical package SPSS (17.0 version for Windows, Chicago, IL, USA) was used for the analyses.

Ethical approval was granted from the Institutional Review Board of E. Wolfson hospital, Holon, Israel.

Results

Between January 1998 and December 2008, 355 NINNM (23.7%) and 1,139 (76.3%) IC TB patients were treated in the Tel Aviv TB clinic, while 222 and 265 of these respectively, were included in the study. The male to female ratio and rate of NINNM to IC in the total sample was not significantly different than that of those who were not selected ($p = 0.06$ and $p = 0.17$, respectively), yet the average age of the sample was 2.3 years younger than that of the patients who were not selected ($p = 0.03$).

NINNM were diagnosed with TB 3.1 ± 2.7 years following their arrival in Israel, and the IC ($n = 165$, 62.5% of all IC) who were born outside Israel were diagnosed 23 ± 17 years after their arrival ($p < 0.01$). Of all NINNM, 109 (49.1%) were born in south-east Asia, 49 (22.1%) in Africa, 39 (17.6%) in eastern Europe, 13 (5.9%) in south America and 12 (5.3%) in the middle east.

NINNM were younger than IC, were more often females, were more likely to originate in high TB burden countries, and to be employed while diagnosed. They were less likely to smoke or be drug/alcohol dependent and had less chronic diseases (Table 1). The proportion of extrapulmonary TB cases among all TB cases in NINNM did not differ from that in IC. NINNM were more likely to have cavitations on chest radiography than IC and had more sputum smear positive, were hospitalised for longer periods and had longer patient delay and shorter system delay. No differences were found in the

TABLE 1

Characteristics of patients included in study, Tel Aviv tuberculosis clinic, 1998-2008 (n=487)

Characteristic		Non-insured non-national migrant N=222 n (%) ^a	Israeli citizen N=265 n (%) ^a	p value
Age at diagnosis (years, SD)		35.0±9.8	53.7±19.7	<0.01
Male sex		101 (45.5)	161 (60.8)	0.01
Originating in high TB prevalence area ^b		213 (95.9)	155 (58.5)	<0.01
Employed while diagnosed		175 (78.8)	75 (28.3)	<0.01
Substance abuse ^c		4 (1.8)	22 (8.3)	0.02
Previous TB diagnosis		13 (5.9)	50 (18.9)	<0.01
Any underlying chronic disease		23 (10.4)	103 (38.9)	<0.01
Smoking ^c		22 (9.9)	92 (34.7)	<0.01
HIV infection		11 (5.0)	5 (1.9)	0.07
Mean time from arrival in Israel to TB diagnosis (years, SD)		3.1±2.7	23±17	<0.01
Any symptom related to TB ^d		161 (72.5)	193 (72.8)	1
Pulmonary TB		158 (71.2)	191 (72.1)	0.8
Pulmonary TB in patients residing in Israel < 5 years		128 (57.6)	47 (17.7)	0.02
Extrapulmonary TB site	Pleura ^e	14 (24.4)	21 (29.5)	0.3
	Lymph nodes ^{e,f}	36 (58.5)	12 (21.6)	<0.01
	Urogenital ^e	3 (3.7)	19 (21.6)	<0.01
	Musculoskeletal ^e	2 (2.4)	6 (6.8)	0.1
	Other sites ^e	9 (11.1)	18 (20.5)	0.07
Cavitations in chest radiography ^g		67 (42.4)	46 (24.1)	<0.01
Sputum smear-positive ^g		79 (50.0)	70 (36.6)	0.04
Culture-positive ^g		106 (67.1)	109 (57.1)	0.05
Resistant to any first-line anti-TB drug ^h		34 (21.5)	30 (15.7)	0.1
Multidrug resistance		4 (2.5)	8 (4.2)	0.3
Hospitalised due to TB		94 (42.3)	114 (43.0)	0.9
Length of hospitalisation (weeks)		9.9±5.9	7.6±7.5	0.04
DOT adherence >80% for six months of treatment		192 (86.5)	229 (86.4)	0.5
Treatment success ⁱ		185 (83.3)	241 (90.9)	0.01
Mean patient delay (days, SD)		33.1±3.6	18.6±2.8	0.01
Mean system delay (days, SD)		48.9±5.3	105.3±11.1	<0.01

Percentages were calculated on the basis of the number of cases for which information was available.

DOT: directly observed treatment; HIV: human immunodeficiency virus; SD: standard deviation; TB: tuberculosis.

^a Unless otherwise specified.^b Above 20 cases per 100,000 population.^c Present or past.^d Cough longer than three weeks, haemoptysis, chest pain, sub-febrile temperature, weight loss, night sweats.^e In extrapulmonary tuberculosis patients.^f If there were multiple sites, the site other than the peripheral lymph node was considered the principle site.^g In pulmonary tuberculosis patients.^h Isoniazid, rifampicin, ethambutol, pyrazinamide.ⁱ Patients who were cured or whose treatment was completed.

TABLE 2

System and patient delay of patients included in study, Tel Aviv tuberculosis clinic, 1998-2008 (n=487)

Characteristic		Patient delay (mean 25±14 days)			System delay (mean 79±42 days)		
		Below the mean N=316 n (%) ^a	Above the mean N=171 n (%) ^a	p value	Below the mean N=282 n (%) ^a	Above the mean N=205 n (%) ^a	p value
Age at diagnosis (years, SD)		43.5±17.7	48.1±13.2	0.02	47.5±19.3	41.6±16.5	0.01
Male sex		171 (54.1)	80 (46.7)	0.2	156 (55.3)	108 (52.7)	0.6
Non-insured non-national migrant		114 (36.1)	96 (56.1)	<0.01	139 (49.3)	74 (36.1)	<0.01
Originating in high TB prevalence area ^b		218 (70.0)	145 (84.8)	<0.01	212 (75.2)	154 (75.1)	0.2
Years from arrival to Israel ^c		15.6±19.1	9.1±15.1	0.01	12.1±17.5	14.5±18.8	0.2
Employed while diagnosed		148 (46.8)	92 (53.8)	0.01	146 (51.8)	93 (45.3)	0.07
Substance abuse ^d		14 (4.6)	11 (6.4)	0.39	14 (4.9)	11 (5.4)	1
Previous TB diagnosis		45 (14.2)	18 (10.5)	0.4	39 (13.8)	24 (11.7)	0.5
Any underlying chronic disease		87 (27.5)	37 (21.6)	0.3	60 (21.3)	66 (32.5)	<0.01
Smoking ^d		86 (27.2)	23 (13.4)	<0.01	52 (18.4)	56 (27.3)	0.05
HIV infection		10 (3.1)	6 (3.5)	0.8	8 (1.8)	8 (3.9)	0.6
Any symptom related to TB ^e		208 (65.8)	26 (15.2)	<0.01	182 (64.5)	39 (19.1)	<0.01
Referral to TB clinic by	Self referral/	N/A	N/A	N/A	5 (2.0)	0 (0.0)	<0.01
	Screening	N/A	N/A	N/A	188 (72.3)	109 (53.7)	N/A
	General practitioner	N/A	N/A	N/A	67 (25)	94 (45.8)	N/A
Extrapulmonary TB		83 (26.2)	50 (29.2)	0.39	74 (26.2)	57 (27.8)	1
Cavitations in chest radiography		24 (7.2)	17 (9.9)	0.01	28 (9.9)	13 (6.4)	0.26
Sputum smear-positive ^f		96 (30.4)	82 (47.9)	0.04	89 (31.5)	78 (38.0)	0.2
Culture-positive ^f		168 (53.2)	94 (55.0)	0.14	133 (47.2)	130 (63.4)	<0.01
Resistant to any first line anti-TB drug ^g		38 (12.0)	25 (14.6)	0.7	30 (10.6)	33 (16.1)	0.6
Multidrug resistance		7 (2.2)	5 (2.9)	0.7	4 (1.4)	8 (3.9)	0.29
Hospitalised due to TB		116 (36.7)	87 (50.9)	0.01	101 (35.8)	103 (50.2)	0.01

HIV: human immunodeficiency virus; SD: standard deviation; TB: tuberculosis.

^a Unless otherwise specified^b Above 20 cases per 100,000 population.^c For patients not born in Israel.^d Present or past.^e Cough longer than three weeks, haemoptysis, chest pain, sub-febrile temperature, weight loss, night sweats.^f In pulmonary tuberculosis patients.^g Isoniazid, rifampicin, ethambutol, pyrazinamide.

rate of multidrug resistance or any single drug resistance between the two groups.

The mean patient delay for all patients in our study was 25±14 days and mean system delay was 79±42 days ($p<0.01$). Longer than average patient delay was more common in older patients, NINNM, those originating from high TB burden countries or who spent fewer years in Israel, those who did not smoke, and patients who were less symptomatic (Table 2). Additionally, those who had longer patient delay also had more cavitations on chest radiography and were more often sputum smear positive or hospitalised for a longer period than those who had shorter than average patient delay. Patients with longer than average system delay were

younger, more often IC, had more underlying chronic disease, were more often smokers and had less TB symptoms.

Multivariate analysis suggested that being a NINNM, asymptomatic or a smoker are factors predicting longer patient delay; while being asymptomatic or having an underlying chronic disease are predicting factors for longer system delay (Table 3).

The rate of treatment success of the entire study population was 87.5% (426/487). Among patients with sputum smear-positive pulmonary TB, 81% (64/79) of the NINNM and 95.7% (67/70) of the IC achieved treatment success, $p=0.01$. Patients whose treatment outcome

TABLE 3

Multiple logistic regression analysis of the factors associated with patient and system delay for patients included in study, Tel Aviv tuberculosis clinic, 1998-2008 (n=487)

Characteristic	Patient delay		System delay	
	p value	OR (95% CI)	p value	OR (95% CI)
Age at diagnosis	0.9	1.0 (0.9-1.1)	0.4	1.0 (0.9-1.1)
Non-insured non-national migrants	0.01	3.5 (1.3-9.5)	0.8	0.5 (0.2-1.1)
Asymptomatic	0.01	1.3 (1.2-1.8)	0.02	1.6 (2.3-3.5)
Originating from a high TB prevalence area ^a	0.7	0.9 (0.3-3.3)	N/A	N/A
Employed while diagnosed	0.5	0.7 (0.3-1.9)	N/A	N/A
Smoking ^b	0.01	2.5 (1.2-5.0)	N/A	N/A
Cavitations on chest radiography	0.8	0.9 (0.9-1.1)	N/A	N/A
Any underlying chronic disease	N/A	N/A	0.03	2.4 (1.1-5.2)
Culture-positive	N/A	N/A	0.1	1.7 (0.9-3.3)
Hospitalisation due to TB	N/A	N/A	0.1	0.6 (0.3-1.2)

CI: confidence interval; N/A: nNot applicable; OR: odds ratio, TB: tuberculosis.

^a Above 20 cases per 100,000 population.

^b Present or past.

TABLE 4

Treatment success for patients included in study, Tel Aviv tuberculosis clinic, 1998-2008 (n=487)

Characteristic	Success N=426 n (%) ^a	No success N=61 n (%) ^a	p value
Age at diagnosis (years, SD)	45±18.01	46.6±21.5	0.52
Male sex	230 (54.0)	32 (52.5)	0.89
Israeli citizen	241 (56.6)	24 (39.3)	0.01
Originating in a high TB prevalence area ^b	97 (22.8)	12 (19.7)	0.74
Employed while diagnosed	217 (50.9)	33 (54.1)	0.63
Substance abuse ^c	21 (4.9)	5 (8.2)	0.35
Any underlying chronic disease	107 (25.1)	19 (31.1)	0.43
Smoking ^c	99 (23.2)	15 (24.6)	0.87
HIV infection	9 (2.1)	7 (11.5)	0.02
Any symptom related to TB ^d	310 (72.8)	44 (72.1)	1
Pulmonary TB	312 (73.2)	37 (60.7)	0.04
Resistant to any first line anti-TB drug ^e	53 (24.4)	11 (18.0)	0.11
Multidrug resistance	10 (2.3)	2 (3.2)	0.646
Lost job due to TB diagnosis ^f	28 (12.9)	16 (48.5)	<0.01
DOT adherence >80% for six months of treatment	398 (93.4)	23 (37.7)	<0.01
Patient delay (days±SD)	25.6±2.5	20.7±5.0	0.48
System delay (days±SD)	80.4±7.3	73.7±12.6	0.75

DOT: directly observed treatment; HIV: human immunodeficiency virus; SD: standard deviation; TB: tuberculosis.

^a Unless otherwise specified

^b Above 20 cases per 100,000 population.

^c Present or past.

^d Cough longer than three weeks, haemoptysis, chest pain, sub-febrile temperature, weight loss, night sweats.

^e Isoniazid, rifampicin, ethambutol, pyrazinamide.

^f Of all patients employed while diagnosed with tuberculosis.

Treatment success was defined as patients who were cured or completed therapy, as classified by the WHO guidelines [12].

TABLE 5

Multiple logistic regression analysis of the factors associated with treatment success, for patients included in study, Tel Aviv tuberculosis clinic, 1998-2008 (n=487)

	p value	OR (95% CI)
Israeli citizenship	0.8	1.08 (0.4-2.9)
HIV infection	0.4	0.4 (0.05-3.0)
Pulmonary TB	0.1	0.49 (0.2-1.3)
Employment sustained (was not discharged)	<0.01	7.65 (2.6-22.7)
DOT adherence >80% for six months of treatment	<0.01	11.2 (3.6-36.6)

CI: confidence interval; DOT: directly observed treatment; HIV: human immunodeficiency virus; OR: odds ratio; TB: tuberculosis.

Treatment success was defined as patients who were cured or completed therapy, as classified by the WHO guidelines [12].

was successful were more commonly IC, HIV-free, had pulmonary TB, kept their jobs during their illness and adhered to the regimen of directly observed therapy (DOT) (Table 4).

Multivariate analysis suggested that having work secured during illness and adherence to DOT are predictors for treatment success (Table 5).

Discussion

Patient delay in this study was longer in NINNM and system delay was longer in IC. The rates of TB treatment success after six months of therapy were inferior in NINNM compared to IC.

NINNM in our study were younger and had better health determinants than IC, similar to findings published earlier in Canada and the US [12,13]. This phenomenon is labeled as the 'healthy migrant effect', and points to the self-selection of healthier and better prepared individuals to overcome the difficulties pertaining to migration [11]. The majority of the IC in our study were born in high TB burden areas and they were older and had stayed in Israel for a longer time than NINNM. Given that Israel is a low TB prevalence country, those IC diagnosed with TB who were born outside Israel were probably infected in their countries of origin before they immigrated to Israel. It is assumed that they developed active TB due to weakening of their immune system, older age, or other concomitant underlying medical conditions.

Although there is no consensus to what length a diagnostic delay is accepted [14], the patient delay in our study and the system delay in NINNM were within the limits of timeframes published from Italy and Spain [10,14,15], yet system delay among IC was much longer, corresponding to findings in a study from Taiwan reporting on system delay in Taiwanese nationals [16]. The majority of IC in our study were older than NINNM and had underlying chronic diseases that might have masked TB symptoms. In our own experience, IC patients usually consult their family physician during the initial stage of their disease, however, the low TB incidence among IC might lead physicians to reduce their index of suspicion regarding the possibility of TB diagnosis. The physicians probably order other tests rather than TB-diagnostic procedures. Cough was found to be a significant complaint associated with system delay among citizens in Brazil, reducing healthcare providers' sensitivity to the possibility of TB, as cough is a symptom for many other respiratory diseases as well [17]. NINNM often consult one of the two general free outpatient clinics in Tel Aviv designated for non-insured patients. Healthcare providers in these clinics are familiar with the specific medical conditions of migrants and are more sensitive to the possibility of TB diagnosis than general physicians in clinics serving IC, and thus generally refer patients to the free TB clinic in a relatively timely manner.

NINNM had longer patient delay than IC, as also found in Italy [14], possibly due to a combination of reasons: lack of medical insurance, non-acquaintance with availability of free TB services, or the efforts necessary to commute to the clinic. Additionally, fear of deportation or discontinuation of their employment and other or social barriers may hinder the migrants of using the available TB services [18]. The outcome of presenting late at a physician was demonstrated in our study. It resulted in a more extensive disease, greater rates of positive smear results and the presence of cavitations on chest radiographs among the NINNM. It may also explain the need for longer hospitalisation for NINNM, possibly because their disease was more progressive and their living conditions did not allow for domestic isolation in the community.

Extrapulmonary TB patients had longer system delay. A possible explanation for this is that the symptoms are often diffuse and non-specific which renders the medical process of differential diagnosis more difficult, and probably leads the physician to search for other causes. Although extra pulmonary TB is seldom infectious, delay in diagnosis may increase morbidity and mortality [10,19].

Treatment success rate in the Tel Aviv TB clinic for the study period was higher than the WHO goal of 85% [20]. Although citizenship was not found to be a variable predicting treatment success by the regression model, IC had better treatment outcome than NINNM in the univariate analysis. Most NINNM who did not reach

treatment success were ‘transferred out’ or ‘defaulted from therapy’ (data not presented), as they either left Israel at their own discretion or that treatment demands of more than six months of therapy made it impossible for them to combine their work duties with clinic visits. It is noteworthy that employment security was a significant predictive determinant for treatment success in our study. Nevertheless, longer patient or system delays were not found to be associated with treatment success, and it may be that the clinics’ outreach efforts for the patients and supporting them in completing treatment, regardless of the severity of the disease, had a positive impact on adherence.

This study is subject to limitations on recall bias, due to the retrospective approach of data collection with resulting uncertainty of the actual onset of symptoms, as well as linguistic and cultural gaps which might limit the effectiveness of the medical interview performed by the physician. However, data were collected in a similar fashion for IC and NINNM alike, and the bias, if it exists, is non-differential and conservative. Additionally, due to the retrospective nature of the study, other determinants such as homelessness, income, education and other health perception attributes could not be ascertained. We also were not able to define whether patients were infected in Israel or acquired the infection in their country of origin, and reactivated in Israel. Finally, the generalisation of the study results to all NNM in Israel may be questionable. Yet, most of the migrant workers, especially those non-insured, reside in Tel Aviv.

Conclusions

NINNM in our study had longer patient delay, while IC had longer system delay. Both delays should be reduced. As many industrialised countries in Europe host migrants, our finding may be valid for organisations providing healthcare for migrants. Health professionals should use the opportunity of TB screenings where performed, to inform migrants about the possibility that TB may develop in later stages, and discuss with them about typical TB symptoms. NINNM in Israel should also be advised about possibilities of free TB treatment, and that care is independent of deportation regulations. Additionally, it would be desirable to establish a system of employment security to counteract the economic instability and to loss of income of NINNM infected with TB. In order to ensure treatment completion, NINNM who return to work at the final stages of their treatment should be provided DOT in a flexible approach, by customising the time and place to make it convenient for the patients, and possibly with financial incentives for them to complete treatment and adhere to follow-up. Finally, primary care physicians should be informed that TB diagnosis in IC is possible, to increase their index of suspicion.

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