Evaluation of the latent tuberculosis screening and treatment strategy for asylum seekers in Stockholm, Sweden 2015–2018: a record linkage study of the care cascade

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The Stockholm Region voluntary latent tuberculosis migrant screening programme shows high participant compliance. However, of 1364 IGRA positive subjects (n=5470) only 358 initiated treatment, primarily due to current conservative local treatment policies https://bit.ly/3aAFoIE

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ABSTRACT
Introduction: About 90% of active tuberculosis (TB) cases in Sweden are foreign born and are mainly due to latent TB infection (LTBI) reactivation. The aim of this study was to assess the current migrant LTBI screening programme with regards to test results and completion of the care cascade.
Method: A retrospective cohort of all 14173 individuals attending a health examination was established for the Stockholm Region 2015–2018 through record-linkage of data extracted from the Swedish Migration Authority and medical records. Screening results, referrals to specialist care and treatment initiation were ascertained through automated data extraction for the entire cohort. Detailed cascade steps, including treatment completion, were analysed through manual data extraction for a subsample of all persons referred to specialist care in the period 2016–2017.
Results: Of 5470 patients screened with an interferon-gamma release assay (IGRA), 1364 (25%) were positive, of whom 358 (26%) initiated LTBI treatment. An increased trend in IGRA-positivity was seen for increased age and TB-incidence in country of origin. Among the IGRA positive patients, 604 (44%) were referred to specialist care. Lower age was the main referral predictor. In the subsample of 443 patients referred to specialist care in 2016–2017, 386 (87%) were invited, of whom 366 (95%) attended. Of 251 patients (69%) recommended for LTBI treatment, 244 (97%) started such treatment and of those 221 (91%) completed it.
Conclusion: The low attrition in patient-dependent cascade steps shows that the voluntary approach works well. Low LTBI treatment attainment is due to the current conservative local treatment policy, which means the vast majority are IGRA-tested without an intention to treat for LTBI.

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Introduction

In many countries with low tuberculosis (TB) incidence (less than 10 per 100 000) a high proportion of cases originate from latent TB infection (LTBI) reactivation among migrants from high-incidence countries (100 or more per 100 000) who have been infected before arrival in the host country [1, 2]. Consequently, LTBI screening and management for migrants is an important intervention to reduce TB incidence in those countries [1, 3, 4].

The TB incidence in Sweden is five per 100 000 (2018) [5]. Approximately 90% of active TB cases notified in Sweden are among migrants and the vast majority of these cases are deemed to be reactivated from LTBI acquired outside of Sweden [5, 6]. Asylum seekers constitute an important migrant subgroup for TB prevention and care in Sweden, as many of them come from high TB incidence countries or have travelled through settings with potentially high TB transmission rates. According to Swedish national guidelines, all asylum seekers along with some other migrant categories (quota refugees and family reunions – henceforth included in the definition of "asylum seekers") are entitled to a free voluntary health examination in primary healthcare [7].

In Stockholm Region, this health examination is centralised at seven designated primary healthcare centres (PHCs). It includes screening for TB symptoms and an exposure inquiry for all. Persons with signs of active TB are referred to specialist clinics at the Karolinska University Hospital. Screening with an interferon-gamma release assay (IGRA) or a tuberculin skin test (TST) is offered to all patients from countries with a TB incidence of 100 or more per 100 000. Contact history or risk factors for infection during migration also trigger IGRA/TST testing. IGRA is the recommended screening methodology for all patients aged ⩾2 years, with TST or IGRA for children <2 years [8]. A chest radiograph is offered to all patients with positive IGRA/TST results. According to regional guidelines, subjects with positive IGRA/TST results who are aged <20 years, or who have a risk factor for reactivation, should be referred to a specialist clinic after chest radiography (a paediatric clinic if aged <18 years) for further evaluation for possible LTBI treatment (figure 1). The most commonly prescribed treatment regimens are daily rifampin

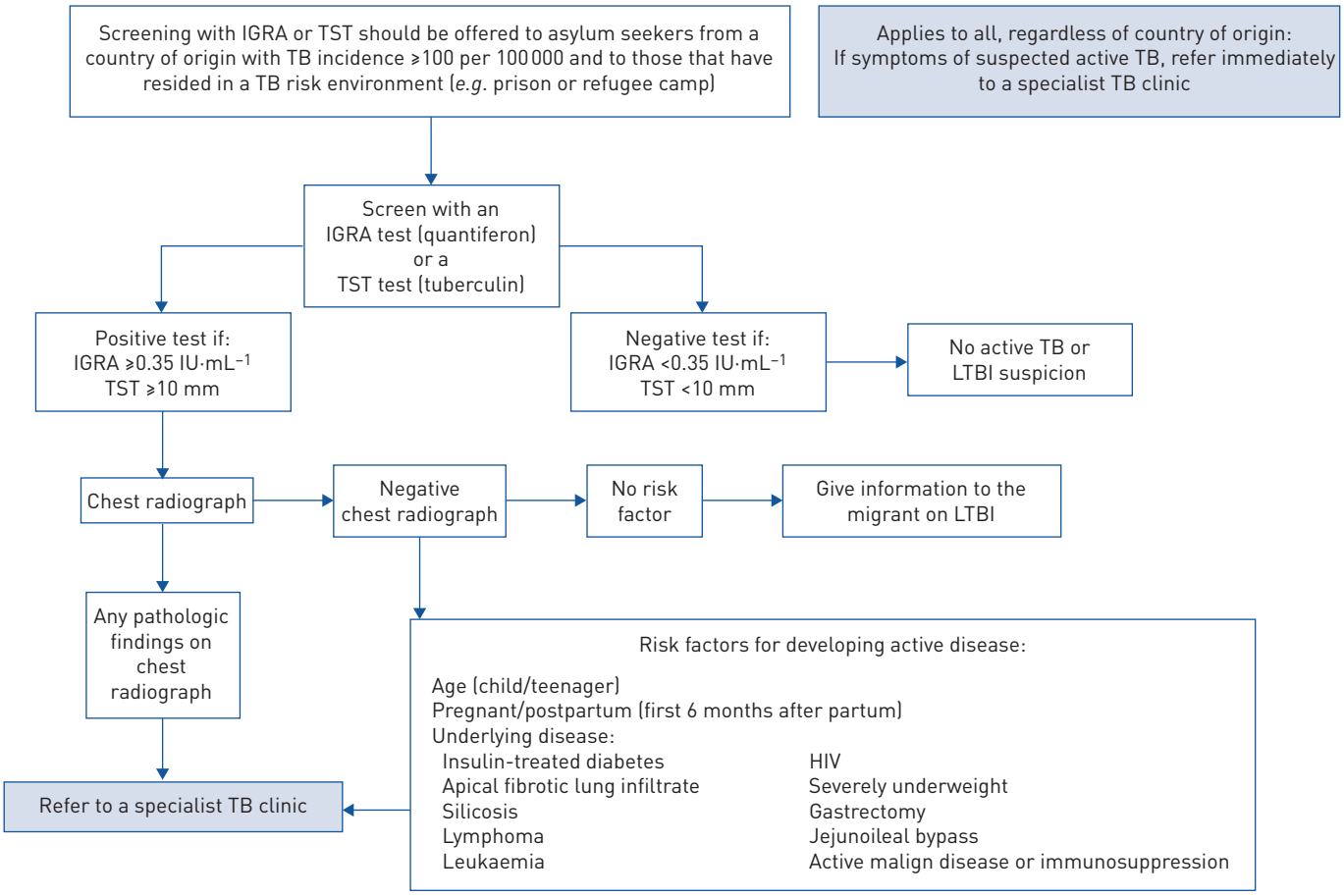

FIGURE 1 Flowchart of tuberculosis (TB) screening of asylum seekers in Stockholm Region (2015–2018). IGRA: interferon-gamma release assay; TST: tuberculin skin test; LTBI: latent TB infection.

(4 months) and a daily combination of isoniazid and rifampin (3 months). The screening guidelines have been in place since the 1990s but have never been evaluated [9]. In Sweden, LTBI is not included in national TB surveillance.

The aim of this study was to assess the performance of LTBI screening for asylum seekers by determining screening coverage, screening results, rate of referral to specialist care, treatment initiation and treatment completion, as well as to identify determinants of completion of each step of the screening and treatment cascade. The study contributes data to a newly built European TB migrant screening database, which has been developed by the E-detect TB project [10].

Methods

Study population, data sources and data collection

The retrospective cohort contained all health examination attendees between January 01, 2015 and December 31, 2018, as obtained from electronic region-wide medical records (the TakeCare main database), with variables from the seven PHCs, specialist care, radiology and laboratory units. Furthermore, age, sex and country of origin were extracted from VeraAsyl and Hälsoplan (ancillary databases) based on migrant data from the Swedish Migration Agency and the Stockholm Region. For extraction, linkage and matching, the universal national personal identification (ID) number (permanent or temporary) was used. Individuals with no information on country of origin (n=14 106) and individuals without a confirmed health examination (n=1397) were excluded from all analyses (n=29 676). A flow-chart of the data linkage and final data set is shown in figure 2. A missing country of origin was due either to a data set non-match or to missing information in VeraAsyl/Hälsoplan. Due to civil administrative procedures, asylum seekers may occasionally be linked to several temporary ID numbers, sometimes including a permanent ID number; however, all were used in linkage. Probabilistic matching using name, age, date of birth and country of origin was applied in <1% of cases lacking an ID number match.

The extraction algorithm identified persons with a registry code specific to a health examination visit. The national personal ID number was then used for TakeCare medical record linkage, in which primary care data was linked to that of specialist clinics. Initiation of LTBI treatment was ascertained based on prescription data using anatomic therapeutic chemical (ATC) classification codes. Missing data for any variable ended further retrieval (known as link breakage). The Stockholm Region E-health unit extracted and delivered the encrypted data to the research team. Data variables extracted are shown in appendix 1.

To validate the data and to enable a detailed description of the linkage-to-care cascade, including treatment recommendations and treatment completion, a manual review of medical records was conducted for the subset of persons referred to a specialist clinic during 2016–2017, excluding 12 persons who were diagnosed with active TB (n=443 total).

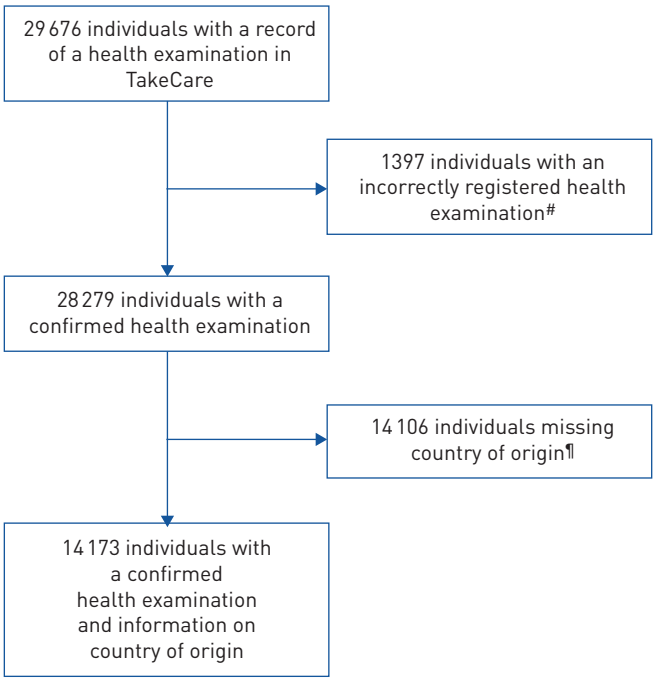

FIGURE 2 Flow chart of the extracted data from TakeCare for individuals attending a health examination (January 01, 2015 to December 31, 2018) and the exclusion criteria through linkage to VeraAsyl and Hälsoplan. #: individuals excluded when the health examination could not be confirmed in VeraAsyl or Hälsoplan; ¶: country or origin data was unavailable due to a non-match between TakeCare, VeraAsyl and Hälsoplan or because the information was missing in VeraAsyl and Hälsoplan.

Statistical analysis

Descriptive analysis was performed on each cascade step, disaggregated by age, sex and country of origin. Incidence in country of origin was categorised based on Swedish notification data [11, 12].

The 2016–2017 subsample analysis also included the association between cascade steps and presence of epidemiological and biological risk factors for active TB. Epidemiological risk factors were considered relevant if they occurred within 2 years prior to referral and were divided into two groups: 1. contact with a known case; or 2. exposure to a high-risk environment such as a refugee camp or prison. Biological risk factors were identified as medical conditions or ongoing treatments which increase the risk of LTBI reactivation (figure 1).

Predictors for the binary outcomes of each step were analysed separately using univariable and multivariable logistic regression. The multivariable analyses included adjustment for sex, age and TB incidence in country of origin. For the 2016–2017 subsample the adjustments also included risk factors.

Data was managed and analysed using Excel (Microsoft Corp., Redmond, WA, USA) and SAS Enterprise Guide 7.1 (SAS Institute Inc, Cary, NC, USA).

Ethical approval

This study protocol received ethical approval from the Regional Ethical Review Board in Stockholm (2016/1974-31/5, 2018/1901-32 and 2016/1648-32).

Results

IGRA screening coverage and results

During the study period 2015–2018, 5470 out of 14 174 subjects with a health examination (39%) were screened by IGRA. Less than 0.1% of all those screened (n=11) had a TST test and therefore were excluded from further analyses. The six most common countries of origin for individuals who were screened by IGRA were Afghanistan (n=1680, 31%), Mongolia (n=621, 11%), Eritrea (n=388, 7%), Somalia (n=296, 5%), Georgia (n=248, 5%) and Ethiopia (n=175, 3%) (table 1).

TABLE 1 Individuals who tested positive by interferon-gamma release assay (IGRA) from a cohort of individuals (n=14 174) who undertook a health examination in Stockholm County (January 01, 2015 to December 31, 2018).

	Patients screened by IGRA	Positive IGRA result[#]	Positive IGRA result by age group[¶] years				
			0–12	13–19	20–34	35–54	55+
Total	5470/14174 (39)	1364 (25)	22/424 (5)	377/1936 (19)	456/1769 (26)	412/1125 (37)	97/216 (45)
Sex							
Male	3781/9342 (40)	946 (25)	15/246 (6)	336/1694 (20)	293/1098 (27)	260/659 (39)	42/84 (50)
Female	1689/4832 (35)	418 (25)	7/178 (4)	41/242 (17)	163/671 (24)	152/466 (33)	55/132 (42)
Country of origin[+]							
Afghanistan	1680/2013 (83)	275 (16)	3/101 (3)	193/1259 (15)	40/209 (19)	24/86 (28)	15/25 (60)
Mongolia	621/993 (63)	207 (33)	5/75 (7)	5/37 (14)	89/258 (34)	99/235 (42)	9/16 (56)
Eritrea	388/466 (83)	101 (26)	0/9 (0)	21/134 (16)	34/120 (28)	27/68 (40)	19/57 (33)
Somalia	296/381 (78)	140 (47)	5/16 (31)	61/141 (43)	36/72 (50)	25/42 (60)	13/25 (52)
Georgia	248/761 (33)	68 (27)	0/27 (0)	2/9 (22)	22/111 (20)	39/92 (42)	5/9 (56)
Ethiopia	175/238 (74)	88 (50)	1/3 (33)	37/62 (60)	31/67 (46)	14/35 (40)	5/8 (63)
Other	2062/9321 (22)	485 (24)	8/193 (4)	58/294 (20)	204/932 (22)	184/567 (32)	31/76 (41)
TB incidence per 100 000 in country of origin							
Epidemiological risk[§]							
<50	580/5641 (10)	82 (14)	4/66 (6)	7/75 (9)	30/273 (11)	31/139 (22)	10/27 (37)
50–99	791/3041 (24)	200 (25)	2/56 (4)	37/106 (35)	62/355 (17)	87/248 (35)	12/26 (46)
All offered screening							
100–199	2585/3302 (76)	563 (22)	4/116 (3)	260/1355 (19)	159/727 (22)	98/288 (34)	42/99 (42)
200–299	741/992 (68)	253 (34)	5/40 (13)	64/164 (39)	86/314 (27)	78/182 (43)	20/41 (49)
⩾300	773/1198 (60)	266 (34)	7/92 (8)	9/52 (17)	119/338 (35)	118/268 (44)	13/26 (50)

Data are presented as n (%) or n/n (%). TB: tuberculosis. [#]: percentage based on the total number of patients screened by IGRA; [¶]: percentage based on the number of positive results for patients screened by IGRA in that age group, one individual was of unknown age; [+]: countries with more than 150 individuals screened by IGRA; [§]: only offered screening if presenting an epidemiological risk factor.

Among those eligible based on country of origin, 4099 out of 5492 subjects had an IGRA test performed (75%). In addition, IGRA was performed on 1371 out of 8682 individuals (16%) who were not eligible based on country of origin but who were judged to present with an epidemiological risk factor. Coverage *via* IGRA testing was higher in country of origin categories with an incidence of 100–199 and 200–299 per 100 000 compared to ⩾300 per 100 000, with adjusted odds ratios (aORs) of 1.44 (95% confidence interval (CI) 1.23–1.68) and 1.43 (95% CI 1.18–1.72), respectively, when adjusted for age and sex (appendix 2, appendix table A2:1). The age group 13–19 years had higher IGRA coverage compared to other age groups. No significant pattern was seen for sex regarding IGRA coverage (appendix 2, appendix table A2:1).

Among subjects screened by IGRA, 1364 (25%) were positive (table 1). Individuals from Ethiopia and Somalia had the highest IGRA positivity (50% and 47%, respectively) (table 1). An increased trend in positivity was seen with higher age and for countries with an incidence of ⩾200 per 100 000 (table 1). These correlations remained significant in multivariable regression (appendix 2, appendix table A2:2). After adjusting for age and country of origin, females were less likely to have a positive IGRA result (aOR 0.74, 95% CI 0.64–0.85) (appendix 2, appendix table A2:2).

Care cascade among those screened positive

Of all 1364 individuals screened positive, 604 (44%) were referred to specialist care and 358 (26%) initiated treatment (table 2 and figure 3). Among those <20 years of age, 294 out of 399 (74%) were referred for specialist care *versus* 310 out of 965 (32%) among those that were ⩾20 years of age. Among all 604 subjects who were referred, 514 (84%) visited the specialist clinic (table 2). Treatment was initiated for 358 out of 514 (70%) of those visiting a specialist clinic, with a higher proportion in the <20 years age

TABLE 2 The latent TB infection (LTBI) cascade of care among individuals with a positive interferon-gamma release assay (IGRA) result in a cohort of asylum seekers (n=1364) in Stockholm County (January 01, 2015 to December 31, 2018)

	Positive IGRA result	Referred to a specialist TB clinic[#]	Visited a specialist TB clinic[¶]	Treatment initiated[+]	Proportion who initiated treatment[§] %
Total	1364	604 (44)	514 (85)	358 (70)	26
Sex					
Male	946	449 (47)	389 (87)	285 (73)	30
Female	418	155 (37)	125 (81)	73 (58)	17
Age group years					
0–12	22	19 (86)	15 (79)	12 (80)	55
13–19	377	275 (73)	263 (96)	248 (94)	66
20–34	456	178 (39)	141 (79)	77 (55)	17
35–54	412	109 (26)	80 (73)	18 (23)	4
55+	97	23 (24)	15 (65)	3 (20)	3
Country of origin					
Afghanistan	275	189 (69)	178 (94)	156 (88)	57
Mongolia	207	48 (23)	36 (75)	13 (36)	6
Eritrea	101	43 (43)	34 (79)	31 (91)	31
Somalia	140	78 (56)	63 (81)	48 (76)	34
Georgia	68	19 (28)	14 (74)	3 (21)	4
Ethiopia	88	41 (47)	38 (93)	32 (84)	36
Other	485	186 (38)	151 (81)	75 (50)	15
TB incidence per 100 000 in country of origin					
<50	82	34 (41)	27 (79)	11 (41)	13
50–99	200	68 (34)	57 (84)	22 (37)	11
100–199	563	307 (55)	277 (90)	234 (82)	42
200–299	253	116 (46)	90 (78)	62 (67)	25
⩾300	266	79 (30)	63 (80)	29 (41)	11

Data are presented as n or n (%), unless otherwise stated. TB: tuberculosis. [#]: percentage based on the total number of patients with a positive IGRA result; [¶]: percentage based on the number of patients referred to a specialist TB clinic; [+]: percentage based on the number of patients that visited a specialist TB clinic; [§]: percentage of those with a positive IGRA result who initiated treatment.

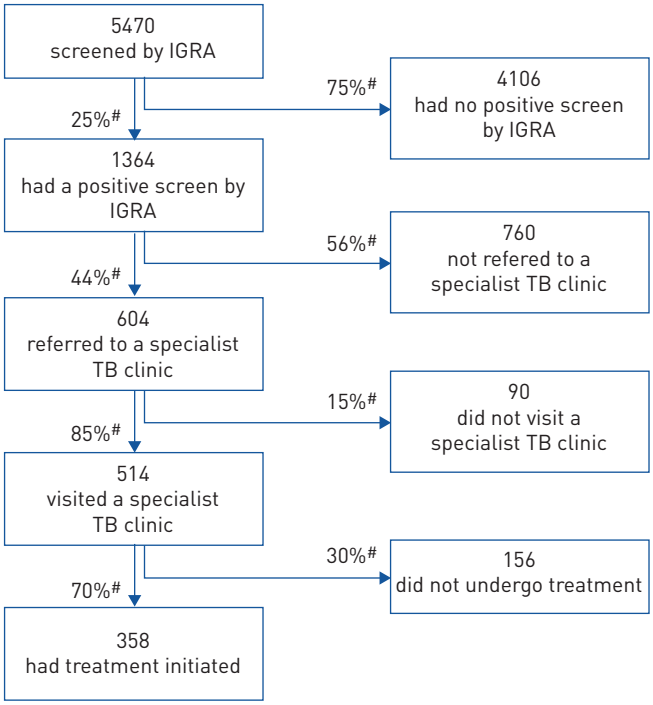

FIGURE 3 Flowchart of the cascade of care in a record-linkage study of asylum seekers (n=5470) screened by interferon-gamma release assay (IGRA) at a health examination in Stockholm Region (January 1st, 2015 to December 31st, 2018). TB: tuberculosis. #: percentage based on previous category.

group (260 out of 278, 94%) than in the ⩾20 years age group (98 out of 236, 42%). Multivariable analysis showed that age was the only significant determinant of completing each of these cascade steps (appendix 2, appendix tables A2:1–A2:5).

Referral completion, treatment initiation and treatment completion in the 2016–2017 subsample of manually reviewed records

In referred individuals, 386 out of 443 subjects (87%) were invited to specialist care, with a decreasing proportion seen with age (table 3 and figure 4). For all individuals who were not invited, the reason stated by the specialist for rejecting referral was noneligibility for treatment according to guidelines. Of the 232 referred individuals in the ⩾20 years age group, 73 (31%) had a recorded epidemiological or biological risk factor (appendix 3). When controlling for sex, age and country of origin, persons with any risk factor were six-times more likely to be invited to specialist care (appendix 4, appendix table A4:1).

Of the 386 subjects invited, 366 (95%) visited specialist care. Treatment was recommended for 251 of these 366 (69%). For those aged <20 years, 176 out of 194 (91%) were recommended for treatment *versus* 75 out of 172 (44%) among those aged ⩾20 years. Multivariable regression shows that age <35 years and female sex were significant predictors of being offered treatment (appendix 4, appendix table A4:3). Of those recommended for treatment, 244 out of 251 (97%) initiated it and among those subjects 221 out of 244 (91%) completed treatment (table 3). Noncompletion of treatment was observed in 23 cases. Of these, 14 out of 23 (61%) were due to an adverse event. As such, 14 out of 244 (6%) of subjects that initiated treatment had it interrupted by adverse events. There were no significant predictors for visiting specialist care when invited, for initiating treatment when recommended, or for completing treatment (appendix 4, appendix tables A4:3, A4:4 and A4:5).

Discussion

Prevalence of a positive IGRA

The overall prevalence of a positive IGRA result was 25% and, as expected, was determined largely by incidence in country of origin and age. Men had a slightly higher prevalence than women in each respective age group and also overall after controlling for age and country of origin. The prevalence amongst those tested was similar in the 50–99 per 100 000 and 100–199 per 100 000 incidence categories. However, the former category was only tested in the presence of epidemiological risk factors (24% tested), which means that this prevalence value may not be representative of all asylum seekers from these countries. Our IGRA data are in line with other recent studies of migrant LTBI screening [13, 14].

TABLE 3 The latent TB infection (LTBI) cascade of care after referral to a specialist tuberculosis (TB) clinic from a review of medical records (n=443) for asylum seekers with a positive interferon-gamma release assay (IGRA) result on health examination in Stockholm County (January 01, 2016 to December 31, 2017)

	Specialist TB clinic			Treatment			Proportion who completed treatment[##] %
	Referred	Invited[#]	Visited[¶]	Recommended[+]	Initiated[§]	Completed[f]	
Total	443	386 (87)	366 (95)	251 (69)	244 (97)	221 (91)	57
Sex							
Male	330	291 (88)	277 (95)	194 (70)	191 (98)	174 (91)	60
Female	113	95 (84)	89 (94)	57 (64)	53 (93)	47 (87)	49
Age group years							
0–12	11	9 (82)	8 (89)	4 (50)	4 (100)	4 (100)	44
13–19	200	191 (96)	186 (97)	172 (92)	172 (100)	162 (94)	85
20–34	129	115 (89)	103 (90)	59 (57)	53 (89)	44 (83)	38
35–54	82	58 (71)	57 (98)	13 (22)	12 (92)	8 (67)	14
55+	21	13 (62)	12 (92)	3 (25)	3 (100)	3 (100)	23
Country of origin							
Afghanistan	160	150 (94)	145 (97)	127 (88)	127 (100)	122 (96)	81
Mongolia	35	27 (77)	25 (93)	10 (40)	9 (90)	7 (78)	26
Eritrea	25	18 (72)	17 (94)	16 (94)	16 (100)	13 (81)	72
Somalia	54	44 (81)	41 (93)	32 (78)	32 (100)	31 (97)	70
Georgia	11	9 (82)	9 (100)	1 (11)	1 (100)	1 (100)	11
Ethiopia	22	21 (95)	20 (95)	15 (75)	14 (93)	11 (85)	52
Other	132	113 (86)	105 (93)	47 (45)	43 (91)	34 (79)	30
Unknown	4	4 (100)	4 (100)	3 (75)	2 (67)	2 (100)	50
TB incidence per 100 000 in country of origin							
<50	33	26 (79)	25 (96)	12 (50)	10 (83)	8 (80)	31
50–99	42	38 (90)	36 (95)	10 (28)	10 (100)	7 (70)	18
100–199	226	204 (90)	196 (96)	162 (81)	161 (99)	150 (93)	74
200–299	85	71 (84)	64 (90)	44 (67)	42 (95)	40 (95)	56
⩾300	53	43 (81)	41 (95)	20 (49)	19 (95)	14 (74)	33
Unknown	4	4 (100)	4 (100)	3 (75)	2 (67)	2 (100)	50
Risk factors							
Epidemiological	52	36 (90)	34 (94)	30 (88)	29 (97)	25 (86)	69
Biological	61	74 (97)	71 (96)	46 (65)	45 (98)	37 (82)	50
Both	10	12 (100)	12 (100)	6 (50)	6 (100)	5 (83)	42

Data are presented as n or n (%), unless otherwise stated. [#]: percentage based on the number of patients referred to a specialist TB clinic; [¶]: percentage based on the number of patients invited to a specialist TB clinic; [+]: percentage based on the number of patients that visited a specialist TB clinic; [§]: percentage based on the number of patients for whom treatment was recommended; [f]: percentage based on the number of patients for whom treatment was initiated; [##]: percentage of those invited to a specialist TB centre who completed treatment.

Attrition along the cascade

As in most other studies attrition was present in each step of the care cascade, starting with IGRA screening where 25% of individuals eligible by country of origin were not tested [15, 16]. Reasons for not testing could not be extracted electronically and, consequently, it is unknown if this was due to provider or patient factors. Individuals may decline in voluntary testing but a previous qualitative study found no indication that asylum seekers would refuse tests during a health examination [17]. Also, IGRA could have been performed elsewhere in Sweden, or staff may have chosen not to test when it was perceived as futile (*e.g.* when asylum was perceived as unlikely to be granted, which was indicated by the low coverage in individuals from some countries associated with low acceptance rates (data not shown)). The highest coverage (83%) was seen among newly arrived asylum seekers from Afghanistan and Eritrea, who were predominantly men under the age of 35 years and who at the time of the study had a relatively high likelihood of being granted asylum [18].

An overall treatment initiation rate of 26% among IGRA positive subjects may seem low, but the current policy recommends referral for treatment in individuals ⩾20 years of age only if additional risk factors are present [8]. Our data indeed suggest that the main reason for attrition was that physicians actually followed guidelines for who to refer and who to recommend for treatment. If anything, physicians seem to have started more persons on treatment than the guidelines suggest, given that the majority of patients >20 years of age who were recommended for treatment did not have any recorded risk factor. We did not

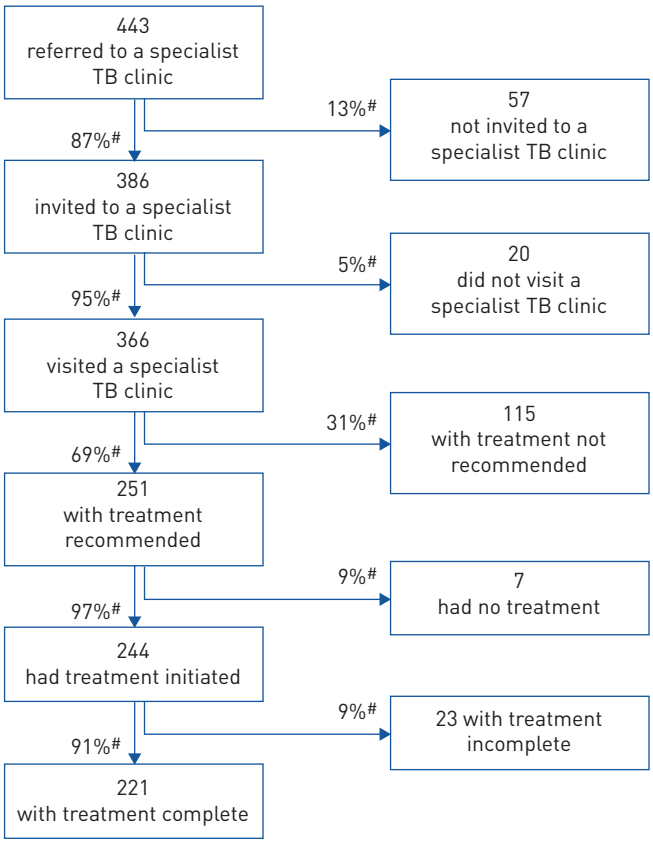

FIGURE 4 Flowchart of the latent TB infection (LTBI) cascade of care in a review of medical records (n=443) for asylum seekers screened as positive by interferon-gamma release assay (IGRA) at a health examination in Stockholm County (January 01, 2016 to December 31, 2017). TB: tuberculosis. #: percentage based on previous category.

collect information on the reasons for this and can only speculate that some clinicians found it appropriate to treat those without listed risk factors (*e.g.* persons between the ages of 20 and 35 years) and perhaps women in particular since pregnancy can also be a risk factor for reactivation.

Notably, the detailed assessment of the 2016–2017 subsample demonstrated that loss related to patient nonadherence was limited (95% of persons invited to a specialist clinic attended, 97% of individuals started the recommended treatment and 91% completed treatment, with most discontinuations being due to side effects). This is in line with findings from a recent qualitative study in Stockholm, in which migrants eligible for LTBI screening and treatment expressed a high level of motivation to adhere [19]. A previous study in Stockholm, from 2013, reported an LTBI treatment completion rate of up to 71% of those who screened positive [9]. Conscious efforts since then to improve patient understanding and motivation, and introduce better treatment support, may in part explain the high level of adherence indicated by the present data [19]. An important conclusion from our study is that the voluntary approach can work well, as echoed by other studies [13, 20].

Good adherence to a questionable policy

Provider factors thus seem more important than patient factors for cascade noncompletion, as health workers follow policy and apply reasonable clinical judgement. As most adults with a positive IGRA result are not offered LTBI treatment due to policy, questioning of that policy is warranted.

First, is the requirement that persons of ⩾20 years of age have risk factors to be eligible for LTBI treatment too conservative? Other countries, as well as other regions in Sweden, recommend LTBI treatment for those up to the age of 35 years [20, 21]. There are no clear international guidelines on the appropriate age threshold and further research is needed to establish the risk–benefit balance and cost-effectiveness for different age groups and risk factor groups [2, 22]. Secondly, is it appropriate to perform an IGRA in persons not eligible for treatment? According to regional policy, IGRA positive persons not eligible for LTBI treatment should receive advice concerning future TB risk and the importance of seeking care if symptoms occur. This strategy is based on sound clinical reasoning but has not been evaluated. On the other hand, "…an intention to screen for LTBI should be the intention to treat LTBI…" is the principle proposed by the World Health Organization (WHO) [14]. However, as an IGRA/TST test is the first step in the screening cascade for both active TB and LTBI in Sweden, the application of this principle is less

than clear. Thirdly, is IGRA the appropriate first screening method for active TB (it is not recommended in any international guidelines)? Although a few cases of active TB were detected within the IGRA positive cohort, this study did not compare alternative detection strategies and thus cannot judge detection efficiency, leaving this third point open.

Further research is needed to evaluate the efficiency of the current policy as compared to other strategies, such as symptom or chest radiograph screening, among persons for whom there is no initial intention to treat for LTBI.

Strengths and limitations

We managed to develop methods to link migration agency data with healthcare data for the entire population of asylum seekers eligible for a health examination in Stockholm, which allowed a comprehensive analysis on the entire cascade of care. It was a major challenge to create the linkage, especially for persons who did not have a permanent ID number (as this is used as the registration number in Swedish medical records). For these individuals we instead used temporary ID numbers, with the drawback that one individual could have several temporary registration numbers in the medical records, making the linkage much more difficult. We now have a linkage system for efficient monitoring of TB screening in the region and expansion of the method to other regions is ongoing. We could not evaluate each step in the cascade through electronic extraction of data due to some information in the sources being available only as free text. We therefore did a manual record review on a subsample, which also served to validate some of the estimates from the electronic extraction. As such we could verify that variables available through both methods were almost identical, meaning that electronic extraction is a viable solution for future surveillance. The only key variable that still requires manual extraction is treatment completion and we are trying to develop recording principles that will make this a directly extractable variable in the future. Finally, although we allowed 3 months from date of health examination to censoring, individuals might have been provided with further care and treatment after the data cut-off point.

The need for better surveillance systems and the way forward

It is crucial for the global TB response that surveillance of LTBI screening is improved to further inform policy. To date there is no comprehensive systematic surveillance of the few ongoing national LTBI screening programmes [10, 13]. TB screening policies across similar European countries are heterogeneous, likely due to the lack of strong evidence and neither the WHO nor the European Centre for Disease Prevention and Control (ECDC) provide clear guidelines specifying which migrants to screen and how [23, 24]. The present poor predictive capacity of available screening tools leads back to the unresolved question of how best to target screening and treatment based on epidemiological and biological risk factors [25]. To adapt and optimise targeting in a reality of fluctuating migration patterns and changing global TB epidemiology requires continuous evaluation of screening strategies. The E-Detect TB project, of which the present study is part and which also includes data from Italy, The Netherlands and the UK, has developed methods to pool such data across countries with the aim of improving surveillance and generating data for policy making. It plans to expand to additional countries, with a view to building a European migrant TB screening database that may inform policy in the participating countries, within Europe and also globally [10, 26].

Conclusion

Our findings suggest that the present screening strategy has been successful in ensuring good adherence both in the target group and amongst the clinicians concerned. Efforts to further improve the effectiveness and efficiency of LTBI screening among asylum seekers should focus on the policy itself. Most critically, the screening of adults should be revised. One option is to discontinue LTBI screening and shift the focus to only detecting active TB in the older age groups. Another option is to raise the age limit for offering LTBI treatment more broadly and exclude subjects based only on individual-level contraindications (which may become increasingly relevant as more evidence on the safety profile of newer treatment regimens emerges). A third option is to do more selective screening in the older age groups (*e.g.* focus only on the highest incidence countries). Cost-effectiveness analyses, as well as comparative analyses of screening strategies in other European countries (*e.g.* within the E-Detect TB database) and globally, will further inform future policy.

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