Latent Tuberculosis Screening Cascade for Non–US-Born Persons in a Large Health System

Adrienne E. Shapiro,[1,2] Ayushi Gupta,[2] Kristine Lan,[2] and H. Nina Kim[1,2]

[1]Department of Global Health, University of Washington, Seattle, Washington, USA, and [2]Department of Medicine, Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington, USA

Review of electronic health records revealed substantial drop-off at each stage of the latent tuberculosis infection (LTBI) care cascade among non–US-born persons in an academic primary care system. Of 5148 persons eligible for LTBI screening, 1012 (20%) had an LTBI test, and 140 (48%) of 296 LTBI-positive persons received LTBI treatment.

The tuberculosis elimination campaign for the United States developed by the Centers for Disease Control and Prevention targets an ambitious goal of <1 case per 1 million population [1]. Since 2001, the majority of tuberculosis cases in the United States have occurred in persons born outside the United States, in persons with infection acquired in their country of origin and disease reactivation after relocating to the United States [2–4]. Guidelines recommend screening all non–US-born (nUSb) persons from tuberculosis-endemic areas for latent tuberculosis infection (LTBI) and treating if infection is present [5, 6]. Despite these recommendations, coverage of LTBI screening and treatment of nUSb persons is not meeting goals set to eliminate tuberculosis in the United States. Although tuberculosis disease is nationally reportable and treatment is coordinated by local health jurisdictions, LTBI screening outside of contact investigations is typically managed in primary or specialty care, and LTBI is not reportable. The overall national prevalence of LTBI in nUSb persons is estimated to be 31% (95% credible interval, 26%–35%), with significant variation by country of origin [7].

The LTBI care cascade is the stepwise process of identifying persons indicated for LTBI testing, administering LTBI tests, identification of positive results, initiating LTBI treatment, and completing LTBI treatment. Missed opportunities and drop-off can occur at each stage of the cascade. Identifying where losses occur is important for targeting interventions to increase the number of people treated for LTBI and progress toward tuberculosis elimination goals. We used electronic health record (EHR) data to assess the retention of nUSb persons along the LTBI care cascade in primary care settings within a large academic medical system serving a community with a high proportion of nUSb persons.

METHODS

Setting

The University of Washington health system (UW Medicine) is a large health system in King County, Washington. Between 2017 and 2021, 25% of King County residents were born outside the United States [8]. UW Medicine provides primary care services through 38 primary care clinics in several models, including clinics in the university hospital; clinics in the university-affiliated safety-net hospital; satellite clinics off hospital campuses (all of which provide primary care irrespective of place of birth); a dedicated immigrant (international) clinic providing primary care to persons born outside the United States, including services for refugees and immigrants; and a human immunodeficiency virus (HIV) clinic providing primary care to persons living with HIV.

Study Population

We reviewed EHR data from all UW Medicine primary care clinics to define a cohort of nUSb adults aged ≥18 years eligible for LTBI screening, and we evaluated the progression along the LTBI cascade for this cohort, including proportions of the cohort screened, of the screened cohort with a positive LTBI result, and of persons with a positive LTBI result who received treatment for LTBI. Demographic data routinely collected in the EHR include age, sex, race, ethnicity, and primary language, but place of birth is not reliably captured with patient registration. We defined nUSb status as having a primary language (1) other than English and (2) spoken in a tuberculosis-endemic country. Languages spoken exclusively in countries with 2019 tuberculosis incidence <20 per 100 000 were excluded.

Persons were considered eligible for LTBI screening if they were nUSb who had a first primary care visit in UW Medicine between 2016 and 2019 and had EHR documentation of attending ≥1 additional primary care visit by April 2021. We defined "screened for LTBI" as the presence of a documented tuberculin skin test (TST) or a laboratory result for an interferon γ release assay (IGRA). Individual record review was

conducted to ascertain TST results. During the study period, the QuantiFERON-TB Gold Plus (Qiagen) test was the IGRA available in the laboratory system.

EHR prescription records were searched to determine whether LTBI treatment was prescribed to persons with positive LTBI screening results. Persons who received treatment for active tuberculosis were excluded. This study was approved by the University of Washington Institutional Review Board, which waived the individual patient consent requirement for retrospective review of medical records.

RESULTS

Between 2016 and 2021, 5148 nUSb persons in primary care at UW Medicine were eligible for LTBI screening. Regarding region of origin, 1880 (37%) were from Asia, 991 (19%) from Africa, 1849 (36%) from the Americas and Caribbean, 213 (4%) from the Middle East/North Africa, 167 (3%) from Eastern Europe, and 38 (0.7%) from Western Europe; the region was unknown in 10 (0.2%). The median age of nUSb adults entering primary care was 41 years (interquartile range, 30–58 years), and 3393 (66%) were female (Table 1). Among nUSb adults eligible for LTBI testing, 1012 (20%) received an LTBI test, including 949 (94%) with IGRA results and 63 (6%) with TST only. Of persons tested, 296 (29%) had a positive test result. Positive results occurred predominantly in persons from Africa (60%), Asia (19%), and the Americas (15%). LTBI treatment was prescribed for 140 (48%) of persons with a positive test result (Table 1 and Supplementary Figure 1). Individual record review of all persons with a positive TST result who did not receive LTBI treatment identified 2 persons with a history of prior tuberculosis treatment who had received LTBI testing in error; they did not contribute to the denominator of persons eligible for LTBI treatment (Supplementary Figure 2).

The proportion of nUSb persons tested for LTBI varied based on the type of clinic attended (Table 1). The nUSb attendees from the HIV primary care (n = 181) and international clinic (n = 280) had the highest rates of LTBI testing (66% and 81%, respectively). Among the nUSb persons (n = 4687) receiving care in university, satellite, or safety net clinics, only 665 (14%) were tested for LTBI.

DISCUSSION

We used electronic health record data to determine the rate of completion of screening and treatment initiation in the LTBI care cascade for a cohort of nUSb adults in primary care. In a large academic health system, 80% of people identified by EHR data as eligible did not undergo LTBI screening. The prevalence of LTBI among nUSb adults was 20%. Of nUSb persons with a positive LTBI test, <50% had evidence of receiving a prescription for LTBI treatment.

Table 1. Clinical and Demographic Characteristics of Non–US-born Primary Care Patient (2016–2021)

Characteristic	Patients, No. (%)[a]	
	No LTBI Testing	LTBI Testing
Sex		
Female	2801 (68)	592 (59)
Male	1335 (32)	420 (41)
Age, median (IQR), y	40 (30–57)	43 (33–59)
Race		
Asian/Pacific Islander	1581 (38)	299 (30)
Black/African American	565 (14)	367 (36)
Other or >1 race	183 (4)	37 (4)
White	1760 (43)	272 (23)
Unknown	47 (1)	37 (4)
Ethnicity		
Hispanic/Latino	1466 (35)	188 (19)
Not Hispanic/Latino	2182 (53)	651 (64)
Unknown	488 (12)	173 (17)
Primary care clinic type		
University campus	554 (100)	0 (0)
University satellite	1641 (85)	299 (15)
Safety net	1827 (83)	366 (17)
HIV clinic	61 (34)	120 (66)
International clinic	53 (19)	227 (81)
No. of outpatient encounters, median (IQR)	4 (2–7)	6 (3–12)
LTBI cascade in persons tested (n = 1012)		
Positive LTBI results		296[b]/1012 (29)
Prescribed LTBI treatment prescribed		140/294[b] (48)

Abbreviations: HIV, human immunodeficiency virus; IQR, interquartile range; LTBI, latent tuberculosis infection.

[a]Data represent no. (%) of patients unless otherwise specified.

[b]Two persons with positive LTBI test results were tested in error; they had known prior tuberculosis treatment.

The proportion of persons completing components of the LTBI cascade in primary care in our study was comparable to findings in a 2022 survey of 15 health department clinics in the United States. Among 11 050 nUSb persons screened for LTBI, 23% were positive, and 43% initiated LTBI treatment [9]. A global systematic review of LTBI care cascades, including 12 migrant cohorts in the United States, Canada, Italy, and Switzerland, found that 43% of migrants identified for LTBI screening underwent testing; among migrants with positive test results, approximately 55% started LTBI treatment [10].

The proportion of nUSb persons screened for LTBI was highest in the HIV primary care and international clinics, where intake procedures specify that all patients receive LTBI testing because of known elevated risks for tuberculosis infection and disease in these populations. In contrast, providers in general primary care clinics may have low awareness of geography-based criteria for LTBI testing. Each additional step that relies on provider-initiated tasks (confirming country of birth, awareness of tuberculosis-endemic status of the country, knowing the guideline recommendation, and ordering

LTBI testing) increases the chances of cascade interruption. Procedures that remove clinical decision making from busy providers may increase the likelihood that testing occurs. If EHRs captured place of birth routinely, this information could prompt an automated or opt-out order for IGRA testing at clinic entry, similar to existing automated age-based prompts for hepatitis C or HIV screening. A record of birth country in the EHR could also facilitate adherence with hepatitis B and other screening guidelines [11].

In this health system, fewer than half of persons with a positive LTBI test result were prescribed LTBI treatment. Although many treatment options for LTBI are available, including shortened regimens of 3–4 months, LTBI treatment awareness is limited and often deprioritized in complex primary care visits addressing multiple active health concerns [12]. In most nUSb persons, IGRAs are the preferred method of testing. A positive IGRA laboratory result appearing in the her could be accompanied by a recommendation for LTBI treatment, a short list of treatment options, and a link to the CDC LTBI treatment website. Reflex guidance, such as radiology reports including guidance for managing incidentally detected pulmonary nodules, improves adherence with recommendations [13]. Leveraging EHR automation to target drop-off points on the cascade involving clinical decision making may offload these tasks from overburdened clinicians and improve retention on the cascade [14].

The EHR assessment approach had several limitations. Because country of origin is not routinely captured for all patients entering the system, we used non-English primary language as a proxy for nUSb status. This underestimates the number of nUSb persons in the health system, because English is the primary language for many nUSb persons, including those from countries with a high tuberculosis prevalence, such as India and many African countries. While non-English primary language is not sensitive, it is highly specific for a country of birth outside the United States. Thus, while the denominator of nUSb persons eligible for LTBI testing is artificially decreased with this approach, it would not affect the proportion of persons tested or the proportion of positive test results, which were similar to LTBI positivity rates in other studies of nUSb persons [7, 9].

Another limitation of the EHR analysis, which accesses laboratory data and procedures in the current system, is that it does not capture any LTBI testing before entry into the system. This approach may overestimate the number of nUSb persons eligible for LTBI testing but would not significantly affect eligibility for LTBI treatment among persons testing positive. Finally, with the available data we were unable to determine LTBI treatment completion, an important final step of the LTBI cascade. In addition, EHR analysis cannot determine the reasons for drop-off at each stage of the cascade. Specifically, it cannot distinguish between patient-level factors

(eg, declining LTBI treatment, concerns about adverse effects or cost, lack of perceived need for treatment, and language and cultural barriers) and provider-level factors (eg, knowledge of indications for LTBI screening and treatment and familiarity with LTBI treatment options).

Despite these limitations, our analysis reveals significant gaps in adherence with the LTBI care cascade for nUSb persons in a large network of primary care clinics. With a set of targeted modifications to the EHR to include country of origin data, automated alerts for indicated screening, and guidance for LTBI treatment with positive test results, health systems could improve completion of LTBI screening and treatment in primary care and facilitate progress toward tuberculosis elimination.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

References

1. Stop TB USA. A call for action on the tuberculosis elimination plan for the United States. Atlanta, GA: Stop TB USA, **2010**.
2. Yuen CM, Kammerer JS, Marks K, Navin TR, France AM. Recent transmission of tuberculosis—United States, 2011–2014. PLoS One **2016**; 11:e0153728.
3. Tsang CA, Langer AJ, Navin TR, Armstrong LR. Tuberculosis among foreign-born persons diagnosed ≥10 years after arrival in the United States, 2010–2015. MMWR Morb Mortal Wkly Rep **2017**; 66:295–8.
4. Centers for Disease Control and Prevention. Tuberculosis cases, percentages, and incidence rates per 100,000 population by origin of birth: United States, 1993–2021. Available at: https://www.cdc.gov/tb/statistics/reports/2021/table10.htm. Accessed 5 April 2023.
5. Mangione CM, Barry MJ, Nicholson WK, et al; US Preventive Services Task Force. Screening for latent tuberculosis infection in adults: US preventive services task force recommendation statement. JAMA **2023**; 329:1487–94.
6. Lewinsohn DM, Leonard MK, LoBue PA, et al. Official American Thoracic Society/Infectious Diseases Society of America/Centers for Disease Control and Prevention clinical practice guidelines: diagnosis of tuberculosis in adults and children. Clin Infect Dis **2017**; 64:e1–e33.
7. Collins JM, Stout JE, Ayers T, et al. Prevalence of latent tuberculosis infection among non-US-born persons by country of birth-United States, 2012–2017. Clin Infect Dis **2021**; 73:e3468–75.
8. US Census Bureau. Population characteristics, King County, Washington. United States Census Bureau. Available at: https://www.census.gov/quickfacts/fact/table/kingcountywashington/POP060210. Accessed 5 April 2023.
9. Holzman SB, Perry A, Saleeb P, et al. Evaluation of the latent tuberculosis care cascade among public health clinics in the United States. Clin Infect Dis **2022**; 75:1792–9.

10. Alsdurf H, Hill PC, Matteelli A, Getahun H, Menzies D. The cascade of care in diagnosis and treatment of latent tuberculosis infection: a systematic review and meta-analysis. Lancet Infect Dis 2016; 16:1269–78.

11. Conners EE, Panagiotakopoulos L, Hofmeister MG, et al. Screening and testing for hepatitis B virus infection: CDC recommendations—United States, 2023. MMWR Recomm Rep 2023; 72:1–25.

12. Szkwarko D, Kim S, Carter EJ, Goldman RE. Primary care providers' and nurses' Knowledge, attitudes, and skills regarding latent TB infection testing and treatment: a qualitative study from Rhode Island. PLoS One 2022; 17:e0267029.

13. McDonald JS, Koo CW, White D, Hartman TE, Bender CE, Sykes AG. Addition of the Fleischner Society guidelines to chest CT examination interpretive reports improves adherence to recommended follow-up care for incidental pulmonary nodules. Acad Radiol 2017; 24:337–44.

14. Tang AS, Mochizuki T, Dong Z, Flood J, Katrak SS. Can primary care drive tuberculosis elimination? increasing latent tuberculosis infection testing and treatment initiation at a community health center with a large non-U.S.-born population [published online ahead of print 2023]. J Immigr Minor Health 2023; 1–13