Journal of Student-Run Clinics
Original Study

Evaluating Patient Profile, Follow-Up Rates and Barriers to Follow-Up at a Student-Run, Community-Based Tuberculosis Testing Program

Sophia Foroushani, MD[1]; Andrew Crawford, MD[2]; Alexandra Woodbridge, MD[3]; Dan Frechtling, MD, MPH[4]; Juzar Ali, MD[5]

[1]Boston Medical Center, Boston University School of Medicine, Boston, Massachusetts, USA
[2]University of California Irvine School of Medicine, Irvine, California, USA
[3]Louisiana State University Health Sciences Center, New Orleans, Louisiana, USA
[4]Tulane University School of Medicine, New Orleans, Louisiana, USA
[5]Department of Pulmonary/Critical Care & Allergy/Immunology, Wetmore Clinic, Louisiana State University Health, New Orleans, Louisiana, USA

Corresponding Author: Sophia Foroushani; email: sophia.foroushani@bmc.org

Published: January, 6, 2022

Abstract

Background: The Tulane Student-Run Tuberculosis (TB) Program provides TB risk evaluation, skin testing (TST), and referrals at six homeless shelters and rehabilitation facilities. To date, there has been no evaluation of the program's patient profile. The objective of this study was to determine the symptoms and risk factors for TB present in the program's clients, calculate follow-up rates for TST reading, and determine factors associated with an increased rate of missing reading appointments.
Methods: This retrospective chart review examines the prevalence of risk factors and TB symptoms, evaluates risk stratification, and determines barriers to follow-up for TST over a 33-month period. Relative risks (RR) were calculated to determine the association between risk stratification, positive TST, and loss to follow-up. Z-values were calculated, and p-values were determined as the area of the distribution outside of +/- z. P-values <0.05 were considered statistically significant.
Results: Of 6,198 individuals seen, 479 were referred to higher care, 238 received 30-day clearances, 34 deferred testing, and four were sent to the hospital. Of 5,443 TSTs placed, 4,155 were read and 214 were positive. Individuals who had any risk factors were at significantly increased risk of not attending TST reading (RR 2.14, 95% Confidence interval [CI] 1.96-2.34, p<0.01) and, for those who did attend, of having a positive TST (RR 1.52, 95% CI 1.17-1.98, p<0.01). Higher risk of no-show and positive TST was also seen in homeless individuals (RR 3.44, 95% CI 2.92-4.07, p<0.01 and RR 2.10, 95% CI 1.52-2.90, p<0.01, respectively) and those with intermediate-risk stratification (RR 1.25, 95% CI 1.11-1.41, p<0.01 and RR 1.32, 95% CI 1.01-1.72, p=0.04, respectively).
Conclusions: Individuals experiencing homelessness and those with intermittent TB risk stratification are at increased risk for positive TST. Both homelessness and the presence of any TB risk factors increase the risk of loss to follow-up.

Introduction

In the United States, tuberculosis (TB) infects approximately 5% of the population.[1] For individuals living in communal housing, the rate is more than double that of the general population.[2] Lifetime risk of progression of latent TB infection (LTBI) to active disease is 5-15%.[3] As such, identification and treatment of LTBI is crucial in order to meet World Health Organization (WHO) goals to eliminate TB.[4] Screening for LTBI requires evaluating high-risk populations, including individuals living in close quarters.[5] For persons with LTBI, risk factors for progression to active TB include many of the risk factors that put individuals at risk for LTBI.[6] Homeless individuals are at particularly high risk, as they are both at increased risk of contracting TB and failure to complete treatment.[7] The WHO suggests that homeless individuals be screened with tuberculin skin testing (TST).[7]

To meet the need for TB screening, the Tulane School of Medicine Student-Run TB Program provides TB risk evaluation and TST, as well as referrals to primary care and pulmonology.[8] A partnership with a state-funded TB clinic allows patients with positive tests to undergo confirmatory testing and treatment. The program has clinics at six sites, all of which are in residential facilities (two in substance use rehabilitation centers and four in homeless shelters), which require patrons to provide proof of TB testing to maintain residence.[8]

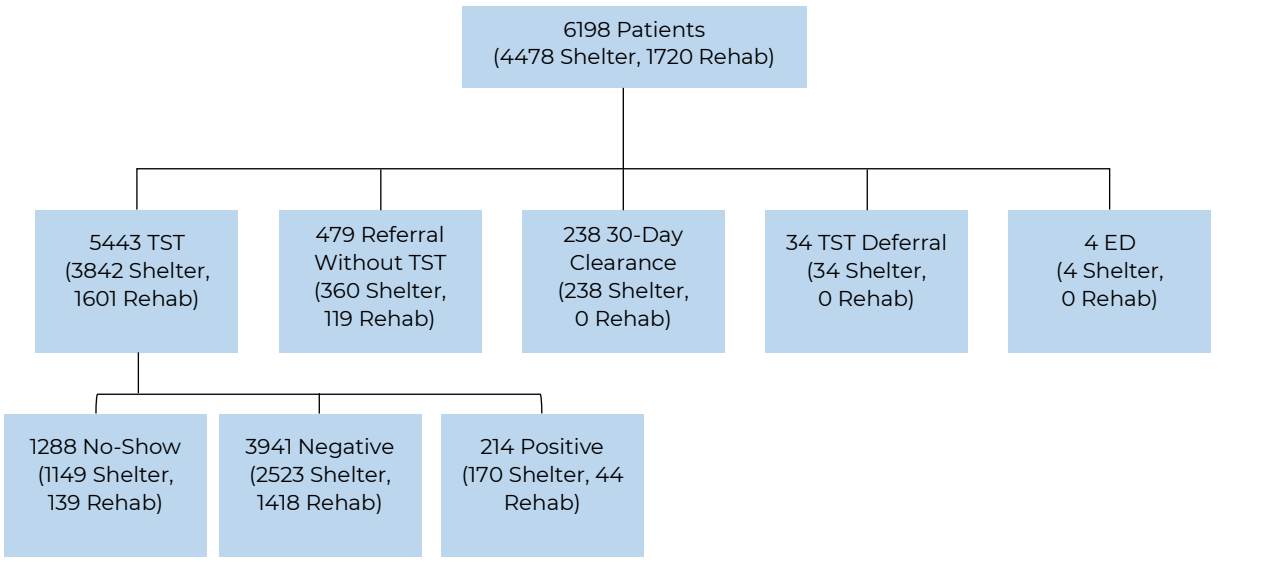
To date, there has been no evaluation of the patient profile within the program, nor has there been an analysis of follow-up rates and barriers to follow-up. Follow-up is particularly important in this patient population, as they are at high risk for attrition from medical care.[9-11] This retrospective chart review aims to determine the symptoms and risk factors for TB present in the program's clients, calculate follow-up rates for TST reading, and determine what factors are associated with an increased rate of missing reading appointments.

Methods

Upon presenting for care at the Tulane Student-Run TB Clinics, medical students guide each patient through a TB questionnaire developed in accordance with Centers for Disease Control and Prevention (CDC) guidelines and assign a corresponding risk stratification (Online Appendix). Individuals with a score of 10 or above, who have active TB symptoms, are considered high-risk for active TB. They are sent to the emergency department for evaluation. Individuals with a score of 3-9 are deemed intermediate-risk and, in the absence of contraindications, are given a TST. Individuals with a risk score of 0-2 are low-risk and, if permitted by the administration of the residential facility, are provided a 30-day clearance. After 30 days they are re-evaluated, and their risk stratification is determined again. Due to administrative reluctance, only two sites have implemented the 30-day clearance program. Individuals must return 48-72 hours after a TST to have their tests interpreted. Negative TSTs result in a 6-month clearance. Those with a positive TST are provided a referral to the state TB clinic. Those with contraindications to a TST are provided a referral to the state clinic without undergoing TST. Contraindications include a previous positive TST, previous TB diagnosis, or Bacillus Calmette-Guerin vaccine.

This study was approved by the Tulane University Institutional Review Board. Medical records for all individuals seen at the program's clinics from January 1, 2017, through October 1, 2019, were abstracted into a database hosted on Research Electronic Data Capture, a secure, web-based application used for data entry and management in research studies.[11] Data were aggregated and analyzed using Microsoft Excel (Version 16.41, Microsoft Corporation, Redmond, WA, USA) and SAS 9.4 (SAS Institute, Cary, NC,

Figure 1. Patient flow



Description of overall patient census and results for the program. TST: tuberculin skin testing; ED: emergency department

USA). Relative risks were calculated to determine the association between risk factor and symptom profile, risk stratification and risk of positive TST or missing the TST reading appointment. Z-values were calculated, and p-values were determined as the area of the distribution outside of +/- z. P-values <0.05 were considered statistically significant.

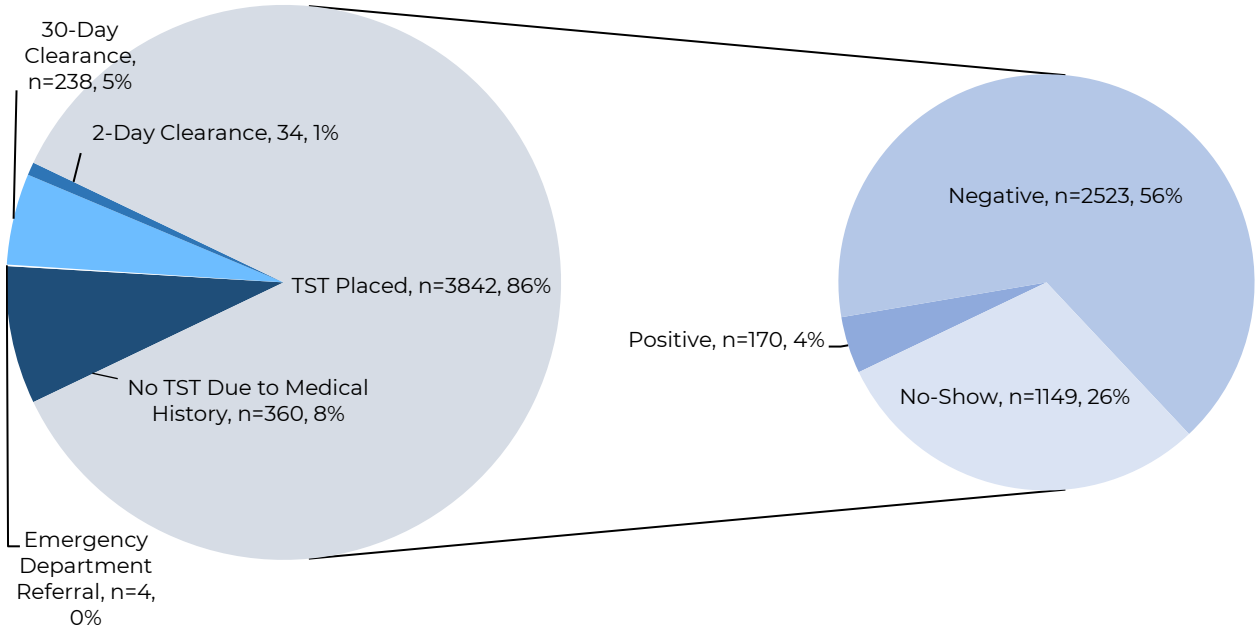
Results

Across six sites, 6,198 individuals were seen (Figure 1). Due to contraindications, 479 received a referral to the state clinic without a TST. 30-day clearance was provided to 238, while 34 received a temporary TST deferral due to not returning for results. Four were sent to the emergency department due to suspicion for active TB. In total, 5,443 TSTs were placed, and 4,155 (76.34%) clients attended their follow-up appointment. Homeless individuals attended their TST reading at a rate of 70.10%, while those in rehabilitation facilities attended their appointments at a rate of 91.32%. Residence in a homeless shelter was associated with a higher risk of missing the TST reading appointment (RR 3.44, 95% CI 2.92-4.07, p<0.01). Of all persons who attended follow-up appointments, 214 had a positive TST, while 3,941 were negative (Figure 2, Figure 3). Low-risk individuals had a positive test rate of 4.48%, while those with intermediate-risk had a 5.92% positive test rate, and high-risk patients who were not referred to the emergency department (due to lack of active TB symptoms) had a positive test rate of 6.58%. Patients with intermediate-risk were significantly more likely to have a positive TST than those with low-risk (RR 1.32, 95% CI 1.01-1.72, p=0.04).

Most clients had no symptoms (n=5,244, 84.61%) (Table 1, Table 2). Of those displaying symptoms, a majority were in homeless shelters, with the most common symptoms being prolonged cough (n=266, 5.94%) and unexplained fatigue (n=219, 4.89%). Most individuals did not endorse any risk factors (n=3,270, 52.76%). Of those with risk factors, the most common was prior incarceration (n=1,896, 30.60%).

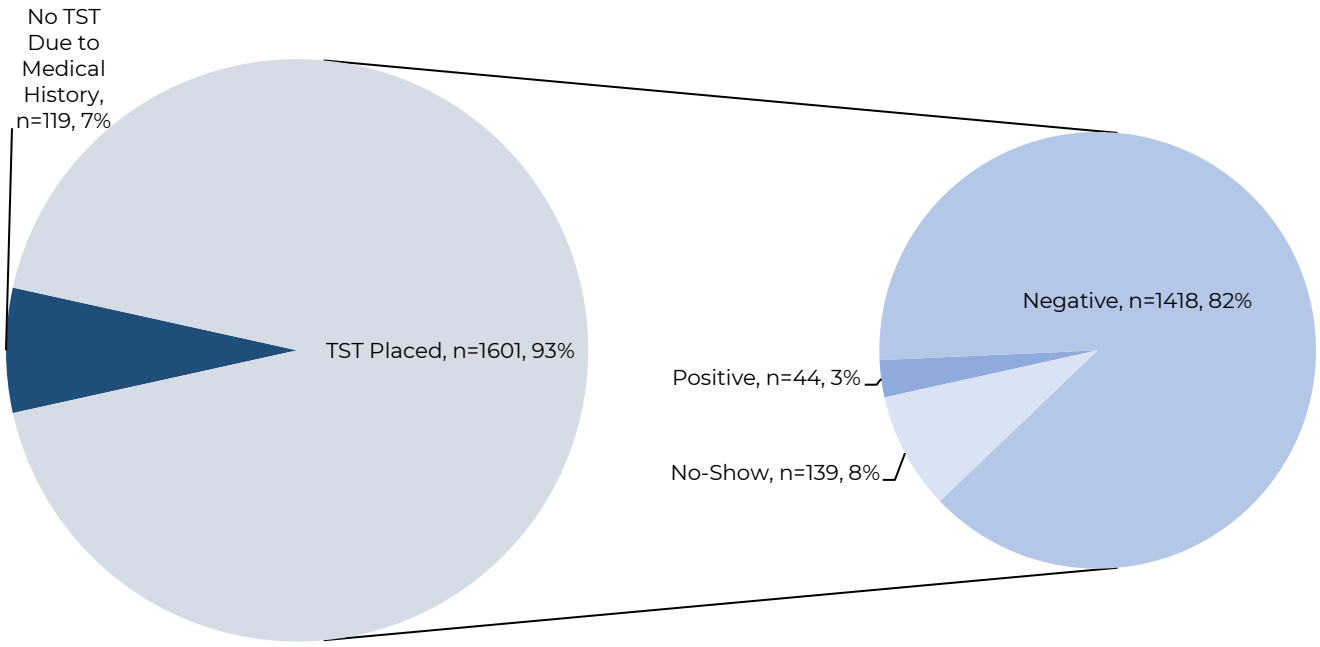
The cumulative symptom and risk factor profile for each person was aggregated in order to evaluate the effect of risk profile on follow-up rates (Figure 4). Having any symptoms was associated with a significant increase in the risk of no show (RR 1.25, 95% CI 1.11-1.41, p<0.01). Having any risk factors was associated with a significant increase in risk of no-show (RR 2.14, 95% CI 1.96-2.34, p<0.01) (Table 3). In evaluating risk stratifications, 2,893 clients (46.68%) were low-risk, 2,449 (39.51%) were intermediate-risk, and 101 (1.63%) were high-risk. Those with low risk were the least likely to

Figure 2. Visit outcomes: homeless shelters (N=4478)



Outcomes of initial patient visits (left) and follow-up appointments for those who had a TST placed (right).

Figure 3. Visit outcomes: rehabilitation facilities (N=1720)



Outcomes of initial patient visits (left) and follow-up appointments for those who had a tuberculin skin test (TST) placed (right).

Table 1. Association of symptoms and risk factors on tuberculin skin test (TST) results

	Positive (n)	Negative (n)	Relative Risk	95% Confidence Interval	P-Value
Symptoms					
None	180	3363	1.00	(Ref)	(Ref)
1-2	28	484	1.08	0.73-1.59	0.71
3-5	6	84	1.31	0.60-2.88	0.50
6-8	0	10	0.89	0.06-13.44	0.94
Any (1+)	34	578	1.09	0.77-1.56	0.62
Risk Factors					
None	88	2053	1.00	(Ref)	(Ref)
1-2	112	1746	1.47	1.12-1.93	<0.01*
3-5	14	140	2.21	1.29-3.79	<0.01*
6-8	0	2	4.03	0.32-51.07	0.28
Any (1+)	126	1888	1.52	1.17-1.98	<0.01*
Risk Stratification Score					
Low	101	2153	1.00	(Ref)	(Ref)
Intermediate	108	1717	1.32	1.01-1.72	0.04*
High	5	71	1.47	0.52-3.50	0.39

Relative risks denote the risk of positive TST.
**statistically significant.*

Table 2. Symptom and risk factor profile of patient population

	n		
Characteristic	**Shelter**	**Rehab**	**Total**
Age (mean, interquartile range)	48, 38-58	40, 31-48	46, 33-56
Active Symptoms	266	21	287
Cough lasting 3+ weeks			
Hemoptysis	18	3	21
Chest pain	112	0	112
Fever/chills	162	16	178
Night sweats	211	33	244
Unexplained weight loss	78	13	91
Hematuria	20	0	20
Severe headache	151	1	152
Changes in bowel habits	112	2	114
Cervical lymphadenopathy	56	0	56
Persistent shortness of breath	118	2	120
Unexplained fatigue	219	5	224
No active symptoms	4422	822	3244
Risk Factors			
Prolonged high dose corticosteroid or immunosuppressant use	179	3	182
Exposure to HIV/AIDS	148	7	155
Close contact with an active TB patient	89	1	90
Silicosis	35	2	37
Coal workers pneumoconiosis or asbestosis	14	0	14
Gastrectomy	160	2	162
Intestinal bypass	137	4	141
Weight 10% or more below ideal body weight	162	1	163
Chronic kidney failure	58	1	59
Diabetes mellitus	395	14	409
Cancer of head, neck, or lung	36	0	36
Blood disorders (leukemia/lymphoma)	42	3	45
Incarceration within 5 years	1660	236	1896
Intravenous drug use within 5 years	734	125	859
Travel to TB-endemic country in previous 5 years for >2 weeks	96	3	99
No risk factors	2655	615	3280

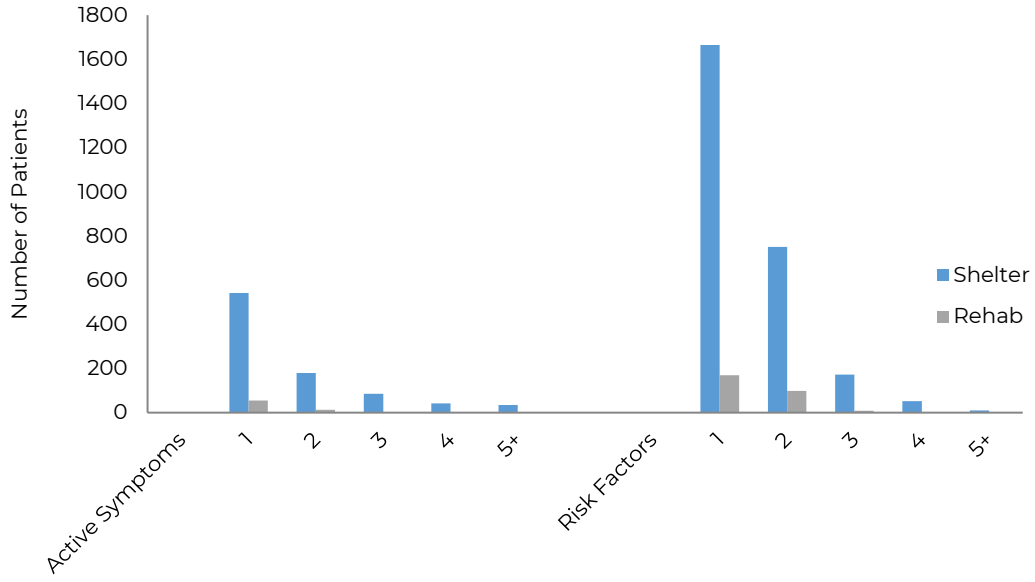
Results of screening questionnaire completed for all patients at their initial appointment. HIV: human immunodeficiency virus; AIDS: acquired immunodeficiency syndrome; TB: tuberculosis

miss their follow-up appointment (n=639, 22.09%), compared to those with intermediate risk (n=624, 25.48%) and high risk (n=24, 24.75%). Individuals with intermediate-risk were significantly more likely to miss their TST reading appointment when compared with those with low-risk stratification (RR 1.15, CI 1.05-1.27, p<0.01). This relationship was not seen when comparing high-risk to intermediate-risk or low-risk individuals (Table 3).

Discussion

Individuals with low-risk stratification have both a higher rate of attending follow-up appointments and a lower rate of positive testing when compared with both intermediate and high-risk groups, though only the difference between low and intermediate-risk groups met statistical significance. These results partially rein-

Figure 4. Cumulative totals: symptoms and risk factors



Number of patients with the indicated number of risk factors or active symptoms residing in a homeless shelter (shelter) vs. rehabilitee facility (rehab).

Table 3. Association of symptoms and risk factors on tuberculin skin test (TST) follow-up appointment

	Show (n)	No-Show (n)	Relative Risk	95% Confidence Interval	P-Value
Active Symptoms					
None	3543	1044	1.00	(Ref)	(Ref)
1-2	512	203	1.25	1.10-1.42	<0.01*
3-5	90	37	1.28	0.97-1.69	0.08
6-8	10	4	1.26	0.55-2.88	0.59
Any (1+)	612	244	1.25	1.11-1.41	<0.01*
Risk Factors					
None	2141	628	1.00	(Ref)	(Ref)
1-2	542	599	2.31	2.12-2.53	<0.01*
3-5	154	60	1.24	0.99-1.55	0.07
6-8	2	1	1.47	0.30-7.30	0.64
Any (1+)	698	660	2.14	1.96-2.34	<0.01*
Risk Stratification					
Low Risk	2254	639	1.00	(Ref)	(Ref)
Intermediate Risk	1825	624	1.15	1.05-1.27	<0.01*
High Risk	76	25	1.12	0.79-1.59	0.52

Relative risk indicates a risk of missing TST reading appointment.
**statistically significant.*

force the utility of this risk stratification method. With increased risk stratification, the rate of no-show for TST reading increases, as does the rate of positive TST. Those who fall into the intermediate-risk category raise particular concern, as low-risk individuals are less likely to test positive and high-risk individuals are more likely to be emergently evaluated. Thus, addressing potential barriers to follow-up in intermediate-risk patients is paramount in improving the program's aim of providing both housing clearance and a public health service.

In the Tulane TB Program, the requirement to return for TST reading 48-72 hours after placement may pose a barrier to care, potentially due to housing instability. This is demonstrated by the significant difference in follow-up rates between shelters and rehabilitation facilities, which indicates that housing instability is a barrier to follow-up in the homeless population. The program could be improved with a coordinated electronic medical record. A shared medical record would enable a placement at one facility to be read at another facility, better accommodating a population that frequently relocates. Currently, all records are paper.

An additional component of the student-run clinic experience that may pose a barrier to follow-up is the length of the process from TST placement to receiving treatment, if indicated. Clients with a positive TST who attend their state clinic appointment receive confirmatory testing with an interferon-gamma release assay (IGRA), chest radiograph, and any other indicated testing. This may require several appointments over a period of up to three weeks. IGRA has been shown to reduce screening costs due to its higher sensitivity and specificity than TST, especially if used alone instead of as a confirmatory test following a positive TST.[14-15] Due to limited resources and personnel, however, this is not currently available for on-site use in the program. There is a high concordance between TST and IGRA results,[1] and thus the continued use of TST is a viable option for the program given limited funding.

To address difficulties with follow-up, several approaches have been attempted. Prior to the start of this study, 30-day clearance cards were implemented for those determined to be low-risk. As the program has limited financial resources, there is a need to stratify individuals based on risk to distribute care most effectively. As there were low rates (<5%) of positive TST in low-risk individuals (compared to those with intermediate or high-risk stratification), it is reasonable to use 30-day clearances. To conserve resources for higher risk clients, the program aims to expand 30-day clearances to low-risk patrons at all clinic sites. A review of the literature does not reveal any programs analogous to that described here. However, an initiative at another institution provided TB screening via questionnaire (without testing) and found a rate of positive screening like the rate of positive TST we demonstrate.[13] Thus, for low-risk populations, this may be a cost-effective option.

Stigma may also contribute to loss to follow-up. TB is stigmatized, and fear of losing housing or work may contribute to lower follow-up rates in individuals with risk factors, symptoms, or positive TSTs.[16] All facilities in which the program operates have agreed that, barring a diagnosis of active TB, individuals with a TB evaluation repeated every six months and who attend all recommended state clinic appointments may retain their residence. Although there is limited data on the efficacy of education on reducing TB stigma, assuring individuals that their housing status is in no way impacted by their TST result may help reduce no-show rates in the program.[16]

There are several limitations to this study. First, the study did not have sufficient power to determine whether each symptom or risk factor was an independent factor contributing to missing TST reading appointments or having a positive test. However, the ability to use risk stratification data circumvents the effects of this limitation on patient care decisions. In addition, some potential confounders, including testing received at other facilities and risk factors not evaluated by our questionnaire (such as employment status, familial obligations, etc.), may have been present in the analysis of follow-up rates, as data was limited to that available in a retrospective chart review. Despite potential confounders, it is likely that the majority of our patient population will benefit from the clinical effects of this risk stratification system, particularly as it relates to housing stability.

Future studies should focus on addressing such confounders to improve the strength of the data and risk stratification through a more complete assessment of the associations between risk factors, symptoms, and positive testing/missing reading appointments. In addition, continued evaluation of follow-up rates after implementation of future quality improvement initiatives will inform best practices for similar programs at other institutions.

Conclusion

Factors associated with a significantly higher risk of positive TST included homelessness and intermediate-risk stratification. Over 70% of clients attended their TST reading appointment.

Most no-shows (89.21%) were from homeless shelters, compared to rehabilitation facilities (10.79%). Significant associations with missing TST reading appointments were found with

homelessness and the presence of any symptoms or risk factors. These findings have significant implications for clinics with limited funding or resources, such as student-run clinics. Identifying individuals who may be at risk for loss to follow-up and targeting interventions to that group could improve both the public health service provided and improve housing eligibility in a vulnerable population. Specifically, ensuring a cohesive communication method between shelter sites would allow patients to return to any site for test reading, thus streamlining care and reducing the burden on both the patient and the healthcare system.

Additionally, this data may be helpful to other institutions currently designing or conducting similar initiatives, as it highlights target populations for dedicated public health interventions in the context of a student-run clinic.

Disclosures

The authors have no conflicts of interest to disclose.

References

1. Miramontes R, Hill AN, Woodruff RSY, et al. Tuberculosis infection in the United States: prevalence estimates from the national health and nutrition survey, 2011-2012. PloS One. 2015;10(11):1-3. LINK
2. Kong P, Tapy J, Calixto P, et al. Skin-Test Screening and Tuberculosis Transmission among the Homeless. Emerg Infect Dis. 2002;8(11):1280-4. LINK
3. Centers for Disease Control and Prevention [Internet]. Tuberculosis (TB): Risk Factors; 2016. Available from: https://www.cdc.gov/tb/topic/basics/risk.htm. LINK
4. Anderson L, Dias HM, Falzon D, et al. Global Tuberculosis Report 2015 [Internet]. Geneva (CH): World Health Organization; 2016. Available from: https://apps.who.int/iris/bitstream/handle/10665/250441/9789241565394-eng.pdf;jsessionid=B216D6F555138A3EF0E89A5657E03C47?sequence=1. LINK
5. Final Update Summary: Latent Tuberculosis Infection: Screening [Internet]; Rockville (MD): United States Preventative Services Task Force; 2016. Available from: https://www.uspreventativeservicestaskforce.org/Page/Document/UpdateSummaryFinal/latent-tuberculosis-infection-screening. LINK
6. Ai J-W, Ruan Q-L, Liu Q-H, Zhang W-H. Updates on the risk factors for latent tuberculosis reactivation and their managements. Emerg Microbes Infect. 2016;5:1-8. LINK
7. Figueroa-Munoz JI, Ramon-Pardo P. Tuberculosis control in vulnerable groups. Bull World Health Organ. 2008;86(9): 733-5. LINK
8. Crawford A, Foroushani S, Woodbridge A, Carsky K, Daniele M, Drury R, et al. Creation and Expansion of a Multisite Tuberculosis Screening Initiative. J Stud Run Clin. 2020;6(1). LINK
9. Nuttbrock LH, Ng-Mak DS, Rahav M, Rivera J. Pre- and post-admission attrition of homeless, mentally ill chemical abusers referred to residential treatment programs. Addiction. 1997;92(10):1305-15. LINK
10. Palmer RS, Murphy MK, Piselli A, Ball SA. Substance user treatment dropout from client and clinician perspectives: a pilot study. Subst Use Misuse. 2009;44(7):1021-38. LINK
11. Stafford A, Wood L. Tackling health disparities for people who are homeless? Start with social determinants. Int J Environ Res Public Health. 2017;14(12). LINK
12. Harris PA, Taylor R, Thielke R, et al. Research Electronic Data Capture (REDCap)- A metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-81. LINK
13. Anand A, Wagner C, Kong SS, et al. Improving screening for latent tuberculosis infection in a student-run free clinic. Cureus. 2018;10(4). LINK
14. Campbell JR, Krot J, Elwood K, Cook V, Marra F. A Systematic Review on TST and IGRA Tests Used for Diagnosis of LTBI in Immigrants. Mol Diagnosis Ther. 2015;19(1):9-24. LINK
15. Nienhaus A, Schablon A, Costa J, Diel R. Systematic review of cost and cost-effectiveness of different TB-screening strategies. BMC Health Serv Res. 2011;11(1):247. LINK
16. Courtwright A, Turner AN. Tuberculosis and stigmatization: Pathways and interventions. Public Health Rep. 2010;125 Suppl 4:34-42. LINK