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UNIVERSITY OF SAN DIEGO
Hahn School of Nursing and Health Science
DOCTOR OF NURSING PRACTICE

Improving Latent Tuberculosis Infection (LTBI) Screening and Treatment in a School-Based
Setting

By

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A Doctor of Nursing Practice Portfolio presented to the
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Abstract

Background: San Diego County's tuberculosis (TB) incidence rate is nearly double than the national rate. In 2019, there have been 5 cases of active TB in the county's public high schools, which have demonstrated the need for prevention interventions in this setting.

Objectives: This evidence-based project is aimed to increase awareness, screening and treatment of latent TB infection (LTBI) in the school setting.

Methods: A TB risk assessment form and consent was sent in the registration packets. A one-time TB educational presentation was given to high school freshman students with a pretest and posttest. For students at-risk, a confidential package was mailed out to parents recommending testing along with a letter to the child's provider offering the option of rifapentine and isoniazid (3HP) to be given at school. Incentives were provided throughout the program.

Results: Following an educational intervention, there was an 18% increase. Out of the 243 Freshman cluster students, 92 (38%) of forms were returned. Approximately 68% of students were found to be at risk.

Conclusions: Like the pilot project, there was a low return of TB risk assessments but a high percentage of students at risk. Future assessments will be needed to determine improving screening efforts

Keywords: latent TB infection, school-based, tuberculosis, screening

Improving Latent Tuberculosis Infection (LTBI) Screening and Treatment in a School-Based Setting

Tuberculosis (TB) is an infectious disease that is one of the top ten causes of death worldwide (World Health Organization, 2018). Latent tuberculosis infection or LTBI, is caused by the *Mycobacterium tuberculosis* bacteria which also causes active TB. The difference between active TB and LTBI, is that the individual with LTBI does not present any symptoms and does not feel sick. LTBI is not contagious, but about 5-10% of those infected will develop active TB in their life (Center for Disease Control & Prevention, 2014).

Because of its close proximity to the Mexican border as well as the diverse immigrant population, San Diego County has encountered an increasing problem of LTBI and active TB over the last 10 years. In 2017, an annual report stated San Diego County's annual TB incidence was 7.1 cases per 100,000 persons, which is higher than the California state rate of 5.2 and more than twice the national rate of 2.8 (County of San Diego Health & Human Services Agency, 2018). Approximately 82% of TB cases result from LBTI reactivation.

In early 2018, two cases of active TB were reported in the San Diego Unified School District (SDUSD). With this outbreak, school administrators and county health officials intervened to determine possible screening and treatment opportunities for students in the school district. According to the California Assembly Bill #1677, anyone employed by a school district is required to have a TB screening; students, on the other hand, do not require screening or testing. This is a problem for a few reasons. One, San Diego has the highest incidence of TB in the United States. Second, adolescents have a much higher risk of progressing to TB disease and can be more contagious when compared to younger children (Hatzenbuehler, Starke, Graviss, O'Brian Smith, & Cruz, 2016).

Previous work, “A Pilot Project for School-Based Direct Observation Therapy for the Treatment of Latent Tuberculosis Infection” (Cunningham, 2019), targeted high school students at risk for LTBI, aiming for an increase in compliance with treatment and prevent future cases of active TB. With the TB risk assessment forms only provided at the registration day, there was a small turnout of students who participated in the project, suggesting that many students from the cluster schools were missed and therefore not screened. Even though the sample was small, there were a large number of students at risk for LTBI.

This current project will aim to fill the gaps missed in the piloted project using an expanded screening process with hopes to improve LTBI screening and treatment. The incoming students’ registration packets were sent out early April 2019 with the TB risk assessment forms will be included. Only students from the cluster schools have been screened with this method, due to compliance with the California Assembly Bill (AB) 699. AB 699 prohibits schools and other educational entities and agencies from inquiring about a new student’s immigration status as well as their country of birth. It has been signed into law to protect students from discrimination and to provide equality.

On the modified TB Risk Assessment form that was sent out to cluster students, one of the questions inquired of the student’s place of birth. After inquiring with local authorities as well as SDUSD, the TB risk assessment form could only be sent out to the cluster students who were previously registered in San Diego County. Students who originated out of San Diego County were unable to participate in the project.

Description of Evidence-Based Project (EBP), Facilitators & Barriers

The purpose of this project is to improve the screening for LTBI and implement a direct observation therapy (DOT) program in a school-based setting, while aiming to increase

awareness and compliance of treatment as well as prevent future cases of active TB. To achieve this, TB risk assessment forms and parental consents were sent out along with the registration packets to incoming freshman students at Lincoln High School. Because of the school's large Hispanic population, forms were provided in both English and Spanish. The DNP student presented a one-time educational intervention (TB presentation with pre- & post-tests) to the freshman students.

After the TB risk assessment forms were collected, an "at-risk" letter was sent out to students notifying them of their risk status and recommendations to seek further LTBI testing. If tested positive for LTBI, students are given two options for treatment: either a nine-month isoniazid (INH) regimen taken daily at home or a three-month INH plus rifapentine (RPT) regimen administered once a week by DOT at the school clinic. Students placed on treatment would be monitored closely for adverse effects and medication compliance.

Facilitators of this project include the school nurses, the school district medical director, county TB control officials, and support from teachers and school administrators. Barriers include medication supply, parental involvement, language barriers, funding availability and legislative education policies. Education and incentives are considered important interventions and will play a major role in the success of this project; the project's funding status is currently pending, and the incentives will be budgeted accordingly.

Evidence-Based Project (EBP) Model

The Iowa Model has been utilized as a tool to help practitioners facilitate change in nursing care. This specific model has been chosen for this project because it incorporates the current evidence and includes the perspectives of practitioners, the healthcare team, and the overall organization (University of Iowa Hospitals and Clinics, 2009). Not only does the Iowa

Model take into account the entire healthcare system, but most importantly, it takes into account the patient (Kowal, 2010). With the changes in healthcare, the Iowa Model has been prompted for re-evaluation, revision and validation (Buckwater et al., 2017).

With this multi-step systematic approach, this project was based on the following: first, a school-based DOT does not exist in California. Second, with the incidence of LTBI and active TB rising, this problem is a priority, especially within the adolescent population. Third, a team was formed with members from SDUSD and the County of San Diego. Fourth, there is sufficient evidence deemed appropriate for a practice change; two high schools in Texas have encountered cases of active TB and have successfully implemented a DOT program within their schools. In combination of the information acquired from research as well as from the pilot project, the practice change was designed. With the assistance from SDUSD and the County of San Diego, the information will be incorporated into the practice change. Lastly, the results of this project will be disseminated to all appropriate parties.

Proposed Evidenced-Based Solutions

Review of the literature was performed using the following search engines: CINAHL, ScienceDirect, PubMed and Google Scholar. In the initial search, the following keywords were used: tuberculosis infection, latent tuberculosis infection, school-based setting, adolescents, and education interventions for parents. The Medical Subject Headings (MeSH) terms used were school-health, tuberculosis, incentives, and adolescents. There was a total of 15 articles used, but 8 articles will be implemented. The evidence used was ranked following the Johns Hopkins EBP Model (Johns Hopkins Medicine, 2017); one article ranked level one, three articles ranked level two, one article ranked level 3 and two articles ranked level 5.

Implementing this project in a school-based setting is ideal. According to Hatzenbuehler et al. (2017), there are many opportunities to educate students about TB as well as improving testing and treatment accessibility in schools. Studies have also shown that utilizing a DOT program in a school-based setting can be a method that correlates with treatment adherence (Cruz & Starke, 2013).

Methods

Participants and Setting

Prior to the start of this project, Institutional Review board (IRB) approval was obtained from the San Diego Unified School District (SDUSD), the University of San Diego and the San Diego Department of Health and Human Services. A total of 243 Freshman students from a public high school in San Diego County participated in this project.

Data Collection

Prior to the start of the 2019-2020 school year, TB risk assessment forms, a consent form and a letter explaining the project were included in the registration packets which were sent out to incoming Freshman cluster students. In the late summer 2019, the investigator attended the Freshman orientation to provide project information to missing cluster students as well as provide additional information to students and their families. All forms were provided in English and Spanish.

The TB risk assessment was formulated using the County of San Diego's (2017) TB Risk assessment and recommendations from the San Diego Pediatric TB Task Force (2017). To simplify the screening process, a golden-colored page was used to correlate with the school health registration form's color; the TB risk assessment questions and a consent form were on one side, in English and in Spanish, respectively. Collected forms were placed in a secure envelope and

were kept in a locked research room. Students who returned their TB risk assessment forms and consent by the selected deadline had their names placed in a raffle drawing for movie tickets.

In the early Fall 2019, a TB education intervention was given to all Freshman students taking physical education (P.E.); a total of 3 fifteen-minute presentations. Due to diminished classroom accommodations, the investigator was not able to provide a PowerPoint presentation but was able to explain the program and promote incentives to participate. A pre- and post-test was administered to the students in 3 P.E. classes. In one class, there were 2 students who did not speak English. The investigator was made aware of this while providing the tests out to the students. Unfortunately, there was no available interpreter to assist the students and were unable to participate in the pre- and post-test. Questions on the pre- and post-test were based on those provided by Hatzenbuehler, Starke, Smith et al (2017) which included identifying what the disease is, how it is transmitted, and determining the student's willingness to be tested and/or treated if diagnosed with LTBI.

Following the deadline, a confidential packet was mailed out to parents/guardians indicating of their child's risk. Parents/guardians of students with one or more positive risk factors were given information on how to get tested, the prizes for returning test results to the school nurse and how to begin treatment for LTBI. The confidential packet included a letter from the San Diego County Department of Health and Human Services to be given to the provider explaining the reason for TB screening, a copy of the TB risk assessment, the County's official TB risk assessment and an official form from SDUSD for the administration of 3HP via DOT at school.

A protocol was created for the school nurse to administer 3HP via DOT. A dose and symptom log were created for the nurse to monitor compliance, side effects and incentives. Gift cards for a retail store were to be given to each student completing the LTBI treatment of their

choice (i.e., self-administration, school administration) in three disbursements of \$10 throughout the therapy and \$20 at completion, for a total of \$50 per student.

Two weeks after distribution of risk assessment results, a phone call was made to parents/guardians of at-risk students for follow up and to ask if the student was tested, where the testing was done, and the results of the testing. For non-English speaking families, a trained interpreter was used. All students who returned their risk assessment to the school nurse had their names placed in a raffle for a pair of wireless headphones.

Data Analysis

Descriptive statistics were obtained using Microsoft Excel for the last three questions of the pre- and post-tests and for the results of LTBI testing.

Results

Program Results

As seen in Figure 1, of 243 students who received the education intervention, 93 (38.3%) students returned the TB Risk Assessment and 27 (29%) students were found at risk for TB with more than one positive risk factor. Table 1 outlines the number of students at risk for each factor. There were four students who were excluded from the group; one student who had completed LTBI treatment prior to the start of the program, two students were not Freshman students, and one student was no longer registered as a student at the high school.

Out of the 23 students with positive risk factors, 9 (39.1%) had more than 2 risk factors. Parents were contacted by their preferred method of choice, by via text, email and/or phone. Investigator was able to follow-up with four parents after one or two attempts; there were 19 (82.6%) unsuccessful follow-ups. Phones out of service or unsuccessful email deliveries were the most common issues the investigator ran into during the follow-ups. At the end of the program,

17.3% ($n = 4$) of the at-risk students were current with their TB testing (3 students had been recently tested for TB; 1 student did not receive the original confidential packet and was tested at a later date). All four students tested negative for LTBI.

TB Education Intervention

Of the 243 Freshman students, there were 76 students who received the education intervention and 82.9% ($n=63$) returned a completed pre- and post-test. The average scores for the pre- and post-test were 59.3% and 77.30% respectively, as noted on Figure 2. Of the three classes, there was an average improvement of 18%. Figure 3 shows the range of students who would have agreed to testing after being told they were at risk for TB. Of the 72 (100%) students who answered this question, there was a positive change above neutral of 81.9% and a negative change below neutral of 18.05% in post-test results. Figure 4 shows the range of students that would have agreed to be treated if they had LTBI. Of 72 (100%) students who answered this question, there was a positive change above neutral of 84.7% and a negative change below neutral of 15.3% in post-test results.

Cost/Benefit Analysis

San Diego County has encountered an increasing problem of LTBI and active TB over the last 10 years. Adolescents have a much higher risk of progressing to TB disease and it can be more contagious compared to younger children (Hatzenbuehler et al., 2016). Not only is tuberculosis a threatening disease, but it can have a tremendous impact on an economic standpoint. In the United States, managing and treating one case of active TB costs \$34,600; to treat a multi-drug resistant strand of TB, the price tag is three times higher, averaging about \$110,900 (Oh, Pascopella, Barry & Flood, 2015). In 2017, the California Department of Public

Health estimated more than \$78 million was spent on managing TB cases (CDPH, 2018). Table 2 compares the costs between this screening program versus active TB treatment.

This project including the resources needed to provide education and incentives to participants approximates to \$1200. To treat one case of active TB costs on average \$34,000. Individuals diagnosed with LTBI have 12% risk of disease progression to active TB (Esmail, Barry, Young, & Wilkinson, 2014). Because of this, screening adolescents is key. With communicable diseases on the rise in California, the overall goal of this project is to promote disease awareness and resources for testing and treatment in high-risk areas.

Discussion

Sending out the TB risk assessment forms along with the registration packets as well as at the time of in-person registration may have promoted better return rates in comparison to the pilot project when forms were only given during in-person registration. The one-time education intervention was successful in increasing knowledge and awareness of TB among students. Following the presentation, students demonstrated an interest to get tested and treated for LTBI. There was a small return of TB risk assessments, a large percentage of students were noted to be high-risk.

There were some limits. Completing follow-up calls with parents/guardians was difficult. After 3 failed attempts from using the preferred method of contact (text, email, phone) no additional attempts were made. Either phones were no longer in service or text and email messages were either returned to sender. One parent stated she had no time to have her child tested because of working multiple jobs. With a large number of students whose parents only spoke Spanish, translation services were used through the San Diego Unified School District.

A few areas of knowledge deficit for students and families were discovered throughout this project: difficulty differentiating active TB disease from LTBI and understanding a positive result for LTBI after a person has been vaccinated with the Bacilli Calmette-Guerin (BCG) vaccine.

Practice Implications

Although only a small portion of the TB risk assessments were returned, including a TB risk assessment form in the registration packets is still one method to identify those at risk for LTBI. In San Diego County, TB screening is required to enter daycare but not for K-12 students (County of San Diego Tuberculosis Control Program, n.d.). Requiring TB risk assessment forms in school registration forms can improve screening methods within San Diego County and San Diego Unified School District. Although not mandatory for students, parents/guardians and staff are required to have a TB risk assessment prior to work/volunteering in the school district (San Diego Unified School District, 2020).

Due to a possible cultural stigma regarding TB, including a brief bilingual/bicultural educational session for parents/guardians during registration could help increase awareness and screening rates in this high-risk population.

With the success of this project, screening for TB will be included in the students' registration. When applicable, the DOT program will be implemented in all schools in the San Diego Unified School District. Utilizing the educational materials created by the CDC and County of San Diego's Public Health Department, we can make sure that audiences of various educational backgrounds will be embraced. By increasing awareness and screening opportunities to adolescents coming from low-income and/or high-risk populations, this will be a stepping stone to increasing healthcare access for all individuals.

Limitations

Most of the Freshman cohort came from outside the cluster of middle schools feeding into this high school, therefore this project included a small percentage of the Freshman class. A few students did not attend this high school when it came to notify of their risk for TB. Due to compliance with the California Education Code, Section 234.7, TB risk assessment forms were only given to students who were previously registered with the San Diego Unified School District, therefore not screening 38% of the Freshman class.

Additionally, many parents were unable to have their child tested due to other obligations. In turn, hopefully future efforts will allow the adequate resources to become available at the high school, allowing easier accessibility to healthcare access. Future improvements of this project depend on the approval of the memorandum of understanding (MOU) with a federally qualified health center; this will allow students to be tested at school with only parent/guardian consent.

Conclusion

With recent instances of active TB cases in high schools, San Diego County has demonstrated the need for improved efforts in TB screening and treatment in its high-risk areas. San Diego has continued to have one of the highest rates of TB in California and almost three times the national rate. In conclusion with this project, results have demonstrated a few things. One, an education intervention should be done to improve awareness and knowledge on TB disease and LTBI. Second, there are a high percentage of students that are at risk for LTBI therefore demonstrating a necessity to screen students. Overall, this project was successful in finding improved screening methods.

Conflicts of Interest

The authors have no conflicts of interest.

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Table 1***Results of TB Risk Assessment form***

TB Risk Factor (n=23)	N(%)
1. Been around someone who had TB	0 (0)
2. History of positive TB test (self/family)	5 (21.7)
3. Born in a high-risk country outside the US	14 (60.8)
4. Been to a high-risk country for >3 weeks	6 (26)
5. Goes to Mexico frequently	8 (34.8)
6. Ever eaten queso fresco or unpasteurized dairy	5 (21.7)
7. Been around someone who is homeless, used drugs or was recently in jail?	0 (0)
8. Takes Prednisone or other medicines that lower the immune system	1 (4.34)
9a. Ever taken medicine for a positive TB Test	3 (13)
9b. Completed treatment	2 (8.7)

Note:

(a) 9 (39.1%) of students had > 2 risk factors; (b) student who completed LTBI treatment were excluded from at-risk group; (c) Questions adapted from San Diego (SD) County TB Risk Assessment and recommendations from the SD Pediatric TB Task Force.

Table 2***Cost-Benefit Analysis***

Resources	Cost	Rationale
Education & Training	\$0.00	Completed during working hours
Educational Handouts	\$400	Educational materials, letters, treatment logs, & forms for 260 freshman students.
IGRA Testing \$35 x 50 students	\$1,750	TB blood test for those >1 risk factor in questionnaire & office visit
Chest X-Ray to rule out active TB (\$36.86 x 20 students)	\$737.20	Rule out active TB students with positive TB test.
DOT program (\$441 x 10 students)	\$4,410	Includes medication, PCP visits, & nurse administration
Total Cost	\$7,297.20	School-based LTBI screening & treatment program
Benefit	Cost	Rationale
1 case of active TB x \$34,000 treatment costs per case	\$34,600.00	
1 case of active TB x \$110,000 in treatment costs of drug-resistant TB per case	\$110,900.00	
Total cost avoidance per 1 case	\$145,000.00	Per 1 freshman student positive for LTBI

Figure 1

Program Results

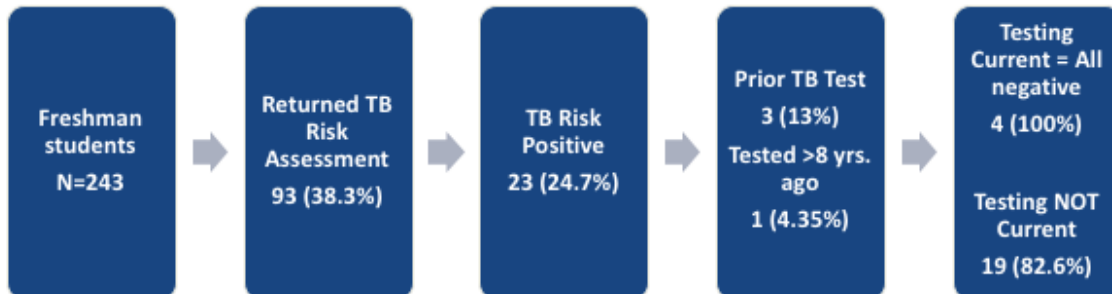


Figure 2

Scores on TB Knowledge

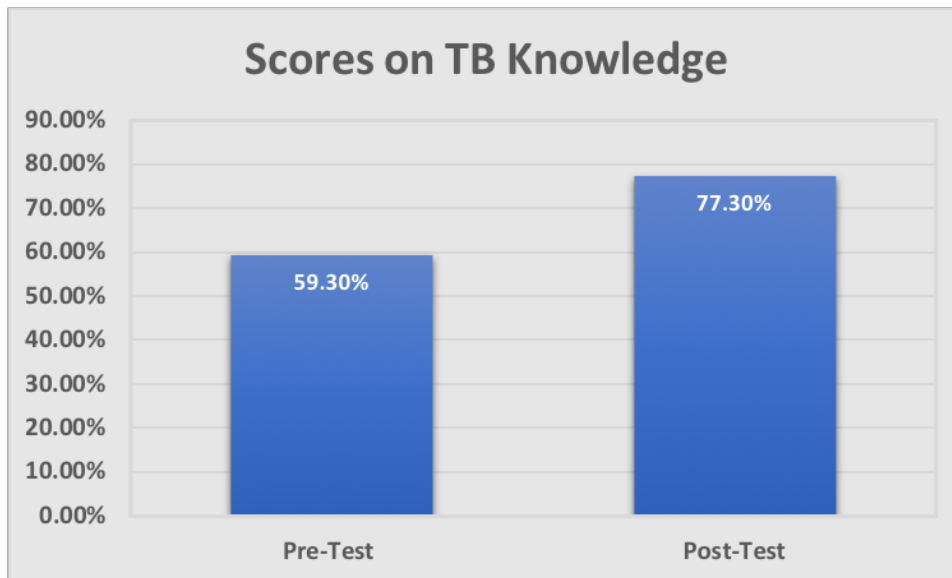


Figure 2. Average scores on TB knowledge of the 3 Physical Education classes.

Figure 3

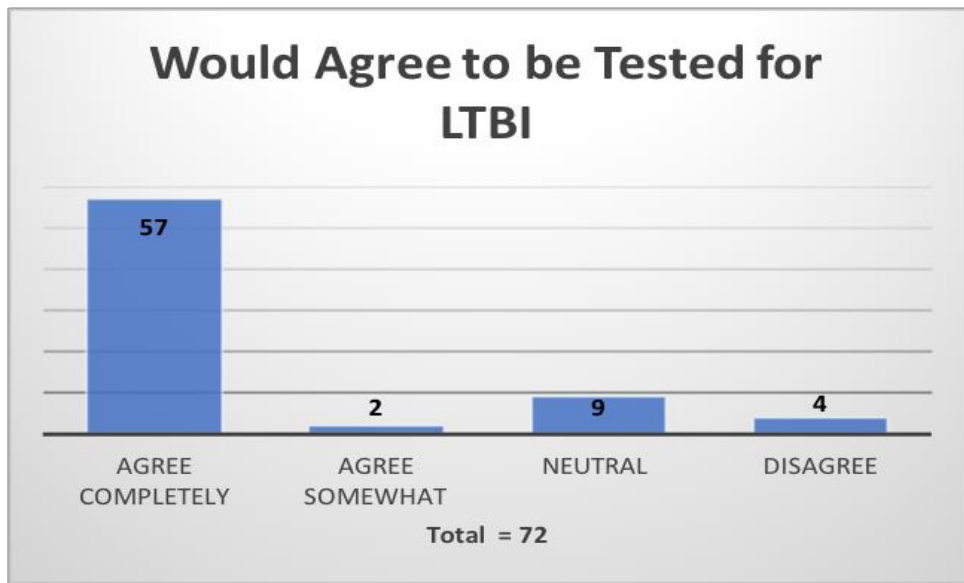


Figure 4:

