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# Resurgence of Tuberculosis at a Large Community Teaching Hospital in the 21st Century – A Quality Improvement Project Evaluating Index of Suspicion, Diagnostic Acumen, and Treatment Efficiency of Tuberculosis from 2010 to 2019

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## 1. ABSTRACT

**1.1. Background:** Numerous studies have documented a delay in diagnosis of pulmonary tuberculosis. We assessed the efficiency of the diagnosis and treatment of tuberculosis at our institution from 2010 to 2019.

**1.2. Methods:** Mycobacterial cultures were reviewed from January 1, 2010 to December 30, 2019. Patients with positive cultures for Mycobacterium Tuberculosis Complex (MTb) were recorded and all patients' charts were reviewed. We recorded date, age, gender, race, country of origin, presenting symptoms, history of TB in patient/family, comorbidities, source of MTb culture, time from admission to recorded suspicion of TB (suspicion interval), time from suspicion to diagnosis (diagnostic interval), time from presentation to treatment (therapeutic interval), and outcome. Patients treated solely in outpatient setting were excluded.

**1.3. Results:** We identified 31 patients with TB from 2010-2019. 5 were diagnosed/treated in the outpatient setting, leaving 26 patients for analysis. Age range was 18-92 years (Mean=52 yrs.). There were 4 African Americans (1 foreign born), 6 Caucasians (1 foreign born), 16 Asians (16 foreign born). 12/26 (46%) had a history of latent TB and 1/26 (4%) had a history of treated active TB. Rapid presumptive diagnosis of TB was made within 72 hours of hospital admission in 17/26 (65%): 7 patients diagnosed with positive fluorescein AFB stains of sputum; 4 patients diagnosed with positive MTb PCR stains of sputum; 3 patients with positive MTb PCR stains of Bronchoalveolar Lavage (BAL) specimens; 2 patients with positive fluorescein AFB stains of BAL specimens; one patient with positive fluorescein AFB smear of hip joint aspirate; and one patient with positive AFB smear of lymph node biopsy. Mean suspicion interval=3.6 days; mean diagnostic interval=9.6 days; mean therapeutic interval=9.1 days. 21 patients survived and 3 patients died (2 unknown).

**1.4. Conclusions:** TB was more common from 2015-2019 than from 2010-2014. Providers recognized TB risk factors quickly, ordered appropriate diagnostic testing rapidly, and diagnosed and treated TB more quickly than anticipated. Physicians were extremely efficient in suspecting, diagnosing and treating active TB from 2010-2019 at our institution.

**2. Keywords:** Tuberculosis, Diagnostic Delay, Diagnostic Accuracy

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## 3. INTRODUCTION

Mycobacterium Tuberculosis (MTb) causes clinical Tuberculosis (TB) and was, prior to the COVID-19 pandemic, the leading infectious cause of death in adults worldwide.[1] The ability of MTb to establish latent infection has enabled it to spread to nearly one-third of the world's population. The greatest barrier to reducing the incidence and mortality of TB is the proportion of persons with TB who are never diagnosed and treated. The WHO estimates that roughly 30% of persons with TB are never diagnosed.[1] This issue has prevented the worldwide elimination of TB. In 2018, the worldwide TB incidence rate was between 1.4 and 2.8 cases/100,000 population.[2] Delay in the diagnosis of tuberculosis has been previously documented at both our institution and worldwide.[3-9] Storla et all's 2008 review of 52 published studies includes >29,000 patients whose mean diagnostic delay was 72 days ± a standard deviation of 28 days.[8] We have recently experienced an increased incidence of tuberculosis locally in the midst of the resettlement of Nepali and Bhutanese immigrants in the City of Akron, Ohio. In order to evaluate our providers' efficiency in diagnosing and treating tuberculosis in the past decade, we undertook this Quality Improvement project. Our pre-study hypothesis was that our physicians, trained after the peak incidence of tuberculosis from 1950 to 1975, would have a delayed recognition and treatment of clinical Tuberculosis (TB).

## 4. MATERIALS AND METHODS

This Quality Improvement Project was approved by the Institutional Research Board, Summa Health, Akron, OH. Summa Akron City Hospital is a 577-bed hospital affiliated with the Northeast Ohio Medical University and hosts 13 Accreditation Council for Graduate Medical Education-approved residency programs and several fellowship programs. All positive mycobacterial cultures at Summa Health were reviewed from Microbiology Laboratory records from 01 Jan 2010 to 31 Dec 2019 (10 years). Patients with positive cultures for MTb were recorded and their charts reviewed. We recorded the date of positive MTb culture, age, gender, race, country of birth, symptoms, patient/family history of TB, comorbid conditions, source of positive MTb culture, time from admission to recorded suspicion of TB (suspicion interval), time from suspicion to diagnosis (diagnostic interval), time from presentation to initiation of treatment (therapeutic interval), and outcome (survival vs. death). Patients diagnosed and treated in the outpatient setting were excluded from the analysis.

## 5. RESULTS

The incidence of TB at Summa Health System, in Summit County (Ohio), and in the United States are illustrated in Figure 1. There was a trend for an increased incidence of TB at Summa Health and in Summit

County, Ohio with a trend for a decrease in cases of TB both state-wide (Ohio) and nationwide (USA). The age range of our patients was 18-92 yrs. (Mean=52 yrs.) There were 4 African Americans (1 foreign born), 6 Caucasians (1 foreign born), and 16 Asians (11/16 were Nepali or Burmese) among the patients with culture-positive TB. 18 of 26 (69%) TB patients were foreign born. 13 of 26 (50%) TB patients had a remote history of latent or active TB: 5 patients previously received 1-drug treatment for latent TB; 1 patient received 6 months of 4-drug therapy for TB; and 2 patients had a family history of active TB. The most common presenting manifestations of TB were: cough (11 pts), fever (6 pts), and hemoptysis (5 pts). The sources of positive cultures for MTb for TB were: sputum in 13 patients (50%); bronchial washings in 6 patients (23%); lymph node biopsy in 3 patients (12%); pleural fluid or peel biopsy in 3 patients (12%); and hip aspirate in one patient (4%). In patients for whom there was a high suspicion of active TB, presumptive treatment was initiated before definitive positive mycobacterial cultures were available. The mean suspicion interval was 3.6 days. The mean diagnostic interval was 9.6 days. The mean therapeutic interval was 9.1 days.

Microbiologically confirmed TB at Summa Health was more common from 2015-2019 than from 2010-2014 (Figure 1). In this QI project, physicians recognized the risk factors for TB quickly (low suspicion interval), ordered appropriate diagnostic testing rapidly, and diagnosed and initiated presumptive treatment for TB more quickly than anticipated. As defined previously, the suspicion interval was 3.6 days, the diagnostic interval was 9.6 days, and the therapeutic interval was 9.1 days. Despite training or practicing during a period of decreasing nationwide incidence of TB, our resident and attending physicians were extremely efficient in suspecting, diagnosing and treating active TB at Summa Health in the 2nd decade of the 21st century.
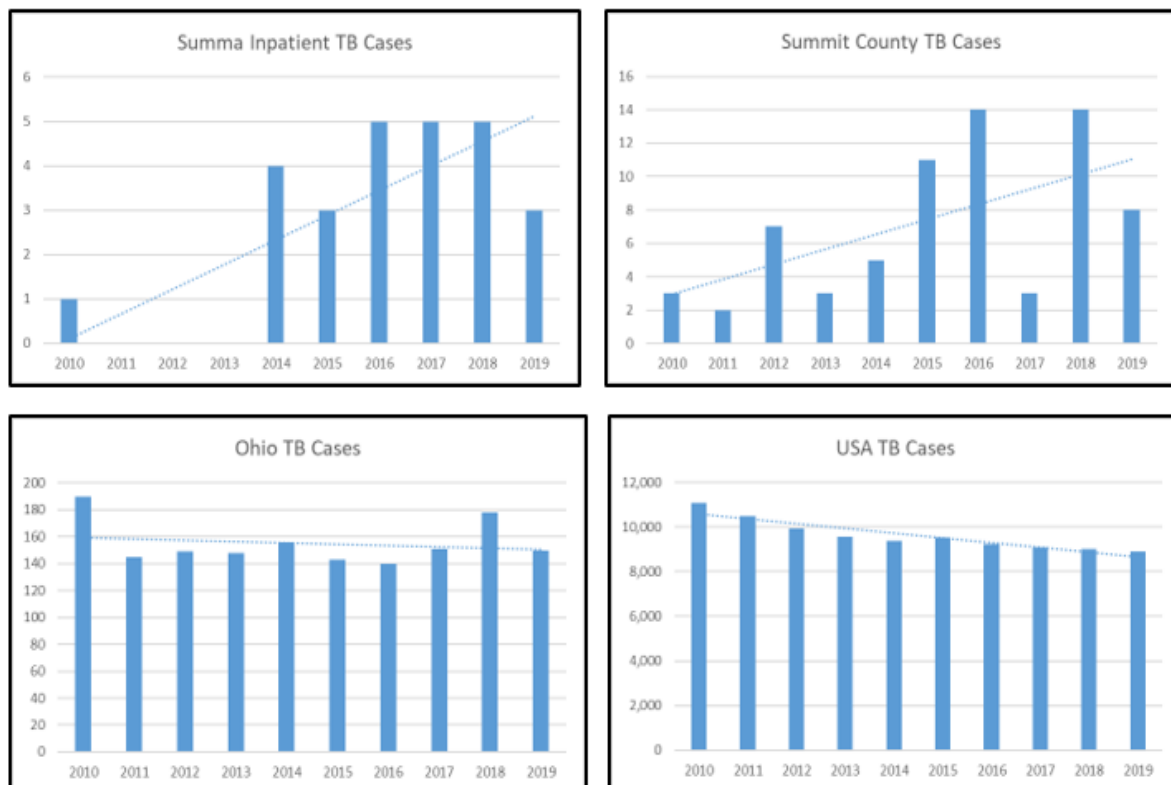
**Figure 1:** Reported cases of tuberculosis by year with trend line at Summa Health; County of Summit, Ohio; State of Ohio; United States of America for Years 2010 to 2019.

## 6. DISCUSSION

The medical literature is replete with studies documenting the delay in diagnosis and treatment of tuberculosis. 52 Studies are summarized by Storla et al in their 2008 publication.[8] The usual diagnostic delay was 60-90 days.[8] The average diagnostic delay in the >29,000 patients reviewed in these 52 studies was 72 days ± a standard deviation of 28 days. Diagnostic delay was associated with patient and provider issues alike. The most common factors associated with delayed diagnosis of TB were human immunodeficiency virus infection, co-existence of chronic cough or other lung diseases, negative sputum AFB smears, extra-pulmonary tuberculosis, rural residence, poor access to healthcare services, poverty, alcoholism, drug abuse, history of immigration, initial visit to a private practitioner, low patient educational level, and low patient and provider TB-awareness. [8] Given the decreasing incidence of TB in both the State of Ohio and the United States as a whole,[2,10] we anticipated a significant diagnostic delay in our institution leading to delayed treatment and tuberculous respiratory exposure of our employees. However, there was neither a diagnostic delay nor an isolation delay at our institution. We are unsure of the factors leading to this unexpected outcome. Ongoing epidemiologic research will focus on identifying the factors that led to this outcome. One factor proposed by some of our internal medicine colleagues is the recent increase in immigration of Nepali and Bhutanese refugees to Akron, OH since 2010. 11 of our 25 patients were Nepali or Burmese immigrants. The outpatient medical care for these patients has resulted in the routine detection of numerous asymptomatic patients having either positive tuberculin skin tests or positive interferon gamma release assays. We hypothesize that this "early detection system" has sensitized local healthcare providers to consider both latent and active tuberculosis in the proper clinical circumstances.

## REFERENCES

1. Global tuberculosis report 2019. World Health Organization, 2019.

2. Tuberculosis in the United States 1993-2018. 2019.

3. Basnet R, Hinderaker SG, Enarson D, Malla P, Morkve. Delay in the diagnosis of tuberculosis in Nepal. BMC Public Health. 2009;9:236.

4. Counsell SR, Tan JS, Dittus RS. Unsuspected pulmonary tuberculosis in a community teaching hospital. Arch Intern Med 1989;149:1274-8.

5. Craig SE, Bettinson H, Sabin CA, Gillespie SH, Lipman MCI. Think TB! Is the diagnosis of pulmonary tuberculosis delayed by the use of antibiotics? Int J Tuberc Lung Dis. 2009;13(2):208-13.

6. Golub JE, Bur S, Cronin WA, Baruch N, Comstock GW, Chaisson RE. Delayed tuberculosis diagnosis and tuberculosis transmission. Int J Tuberc Lung Dis. 2006;10(1):24-30.

7. Rao VK, Iademarco EP, Fraser VJ, Kollef MH. Delays in the suspicion and treatment of tuberculosis among hospitalized patients. Ann Intern Med. 1999;130(5):404-11.

8. Storla DG, Yimer S, Bjune GA. A systematic review of delay in the diagnosis and treatment of tuberculosis. BMC Public Health. 2008;8:15.

9.  Tattevin P, Casalino E, Fleury L, Eggman G, Ruel M, Bouvet E. The validity of medical history, classic symptoms, and chest radiographs in predicting pulmonary tuberculosis: derivation of a pulmonary tuberculosis prediction model. Chest. 1999;115(5):1248-53.

10. Ohio Department of Health. The Year in TB: 2020. World Wide Web: Ohio Department of Health; 2020