Tuberculosis Diagnostic Delays and Treatment Outcomes among Patients with COVID-19, California, USA, 2020

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We assessed tuberculosis (TB) diagnostic delays among patients with TB and COVID-19 in California, USA. Among 58 persons, 43% experienced TB diagnostic delays, and a high proportion (83%) required hospitalization for TB. Even when viral respiratory pathogens circulate widely, timely TB diagnostic workup for at-risk persons remains critical for reducing TB-related illness.

California typically reports one quarter of tuberculosis (TB) cases in the United States and had a 19% case decline during 2020 (*1*). That decline paralleled national and global observations during the COVID-19 pandemic (*1*,*2*). Pandemic-related disruptions challenged healthcare systems and TB control programs by diverting staff and other resources (*3*,*4*). Pandemic effects on TB diagnostic and care delays in the United States have not been fully described. We aimed to characterize missed opportunities and diagnostic delays, hospitalizations, and treatment outcomes in a subset of patients in California who had TB and COVID-19 during 2020. The California Department of Public Health, Centers for Disease Control and Prevention, and participating local health departments reviewed and approved this activity. This study was conducted consistent with applicable federal and Centers for Disease Control and Prevention policies (Appendix, https://wwwnc.cdc.gov/EID/article/30/1/23-0924-App1.pdf).

The Study

Using surveillance records of TB and COVID-19, we used name-based probabilistic matching to find persons with diagnosed TB and COVID-19 in California (*5*). We abstracted records for 58 patients who had TB disease diagnosed in 2020 and COVID-19 diagnosed within 120 days and who resided in 6 local health jurisdictions with high TB burdens: Los Angeles, San Diego, Santa Clara, Orange, Alameda, and Sacramento Counties (Figure 1). We captured TB and COVID-19 symptom profiles and timing, chest imaging results, TB diagnostic testing, and hospitalizations from TB program, hospital, emergency department, and outpatient records, and from death certificates. We also obtained PCR and antigen-based COVID-19 test results, including negative results, beginning on March 9, 2020. We performed statistical comparisons by using 2-sided χ^2 or Fisher exact tests for categorical data and Wilcoxon 2-sample tests for continuous data ($\alpha = 0.05$) (Appendix).

Among 58 patients with COVID-19 and TB, 51 had pulmonary or pleural TB disease. The median time from symptom onset to TB diagnosis was 29.0

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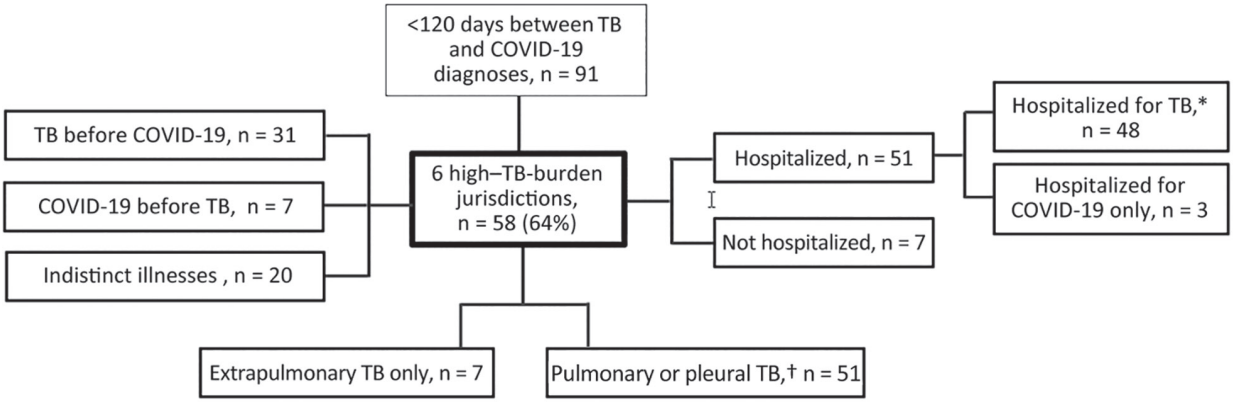

Figure 1. Flowchart of patients included in a study of TB diagnostic delays and treatment outcomes among patients with COVID-19, California, USA, 2020. TB high-burden counties included were Alameda (excluding the city of Berkeley), Los Angeles (excluding the cities of Long Beach and Pasadena), Orange, Sacramento, San Diego, and Santa Clara. Excluded cities maintain independent surveillance registries. *Includes TB patients also hospitalized for COVID-19. †Includes 3 patients with pleural TB only. TB, tuberculosis.

(interquartile range [IQR] 5.0–95.0) days. Twenty-two (43%) patients had a diagnostic delay of >30 days (median 95.0 [IQR 60.0–117.0] days) between TB symptom onset and first TB clinical consultation (Table 1; Appendix Table). Patients with diagnostic delays had indicators of more severe TB, such as

Table 1. Characteristics of 51 persons with pulmonary or pleural TB in a study of TB diagnostic delays and treatment outcomes among patients with COVID-19, California, USA, 2020*

Characteristics	Diagnostic delay†	No diagnostic delay
All pulmonary or pleural cases‡	22	29
Median days between symptom onset to first TB care visit (IQR)	95.0 (60.0–117.0)	5.5 (2.0–13.0)
Age, y (IQR)	55.5 (42.0–71.0)	58 (49.0–77.0)
Sex		
M	11 (50.0)	22 (75.6)
F	11 (50.0)	7 (24.1)
Hispanic or Latino ethnicity	13 (59.1)	17 (58.6)
Healthy Places Index score in 1st quartile§	10 (45.5)	10 (34.5)
Primary language non-English, n = 46	13 (59.1)	18 (66.7)
No health insurance	2 (9.5)	7 (28.0)
Essential worker¶	8 (36.4)	4 (14.3)
No. underlying conditions		
0–1	9 (40.9)	12 (41.4)
≥2	13 (59.1)	17 (58.6)
Smear-positive, cavitary, or disseminated pulmonary TB#	**19 (86.4)**	**16 (55.2)**
Mycobacterium tuberculosis NAAT testing done	21 (95.5)	23 (79.3)
Positive *M. tuberculosis* NAAT	18 (85.7)	16 (69.6)
M. tuberculosis NAAT done before or within 7 d of TB diagnosis	19 (90.5)	18 (78.3)
Recent secondary TB case among cases with genotype**	4 (18.2)	3 (10.3)
Diagnosed with COVID-19 during period of elevated COVID-19 incidence††	**18 (81.8)**	**16 (55.2)**
Missed opportunity for pulmonary TB diagnosis	6 (27.3)	2 (6.9)
Order of disease		
TB first	7 (31.8)	8 (27.6)
COVID-19 first	2 (9.1)	3 (10.3)
Not distinct	7 (31.8)	12 (41.4)
≥1 episode, asymptomatic or with unknown symptoms	6 (27.3)	6 (20.7)
Death	2 (9.1)	6 (20.7)
ICU and intubated while hospitalized for TB	1 (50.0)	3 (50.0)
Died in hospital	1 (50.0)	4 (66.7)

*TB–COVID-19 co-infected patients had TB and COVID-19 diagnoses within 120 d of each other, whereby ≥1 of the diseases was diagnosed in 2020. Included California jurisdictions were Alameda, Los Angeles, Orange, Sacramento, San Diego, and Santa Clara Counties. Values are no. (%) except where indicated. Bold text indicates statistical significance (p<0.05). ICU, intensive care unit; NAAT, nucleic acid amplification test; TB, tuberculosis.
†Diagnostic delay was defined as >30 d between TB symptom onset and first care visit for TB.
‡Extrapulmonary-only cases not included.
§The Healthy Places Index combines 25 community characteristics, such as access to healthcare, housing, education, and more, into a single indexed score; 1st quartile is the least advantaged score.
¶Work that must be done in person and in which the worker interacts with other workers or the public.
#Disseminated TB is defined as meningeal, miliary, positive acid-fast bacilli blood culture, or both pulmonary and extrapulmonary TB.
**Based on phylogenetic analysis (≤5 single-nucleotide polymorphisms) and timing (<3 y) or epidemiologic link.
††California 7-d average incidence of new COVID-19 cases ≥15 cases per 100,000 population.

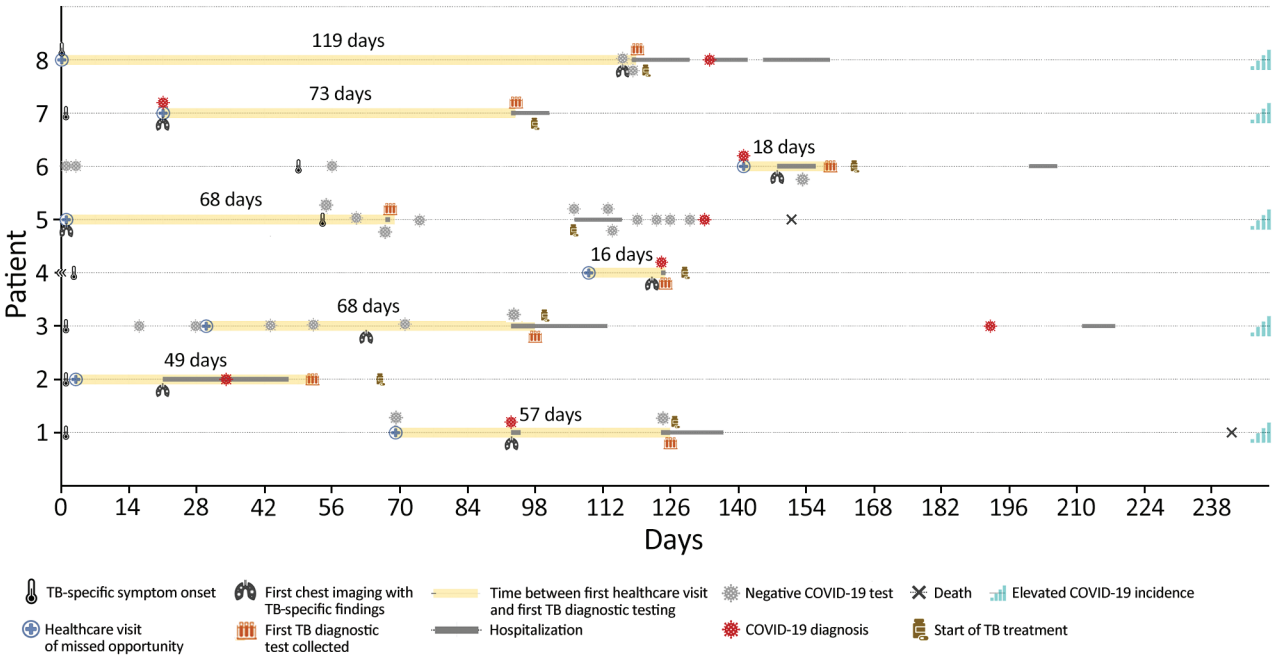

Figure 2. Timeline of 8 patients included in a study of TB diagnostic delays and treatment outcomes among patients with COVID-19, California, USA, 2020. Symptom onset is the date the first symptoms compatible with either TB or COVID-19 was identified. Symptom onset for patient 6 was in June 2019. Patient 7 was hospitalized for reasons unrelated to TB or COVID-19, and the TB diagnostic work-up was prompted by incidental findings on chest imaging. The healthcare visit of a missed opportunity to diagnose TB in a person with TB risk factors was a visit where ≥1 symptom or chest imaging finding was known. Yellow shading captures the number of days between the first missed opportunity and the first specimen collection for a TB diagnosis. Elevated COVID-19 incidence in California was considered ≥15 cases/100,000 population (7-day average rate). TB, tuberculosis.

acid-fast bacilli smear–positive sputum, cavitary imaging results, or disseminated pulmonary disease, than patients without diagnostic delays (86% vs. 55%; p = 0.02). Diagnostic delays were marginally more common among persons with COVID-19 diagnosed during periods of elevated incidence, considered the statewide 7-day average COVID-19 incidence rate of ≥15 cases/100,000 population, than persons diagnosed at periods without elevated incidence (82% vs. 55%; p = 0.05).

Among 51 patients with COVID-19 and pulmonary or pleural TB, 8 (16%) had ≥1 missed opportunity for TB diagnosis. We defined a missed opportunity as a documented clinical encounter in which a person with TB risk factors (e.g., experiencing homelessness or being non–US-born, in a correctional facility, or HIV-positive) had TB-specific symptoms but no TB diagnostic testing. TB-specific symptoms were hemoptysis, weight loss, or cough ≥3 weeks, or chest imaging of cavity, tree in bud pattern, pleural effusions, nodules, miliary, or upper lobe infiltrate; TB diagnostic testing included acid-fast bacilli smear or *Mycobacterium tuberculosis* nucleic acid amplification test. The median time between the first missed opportunity and start of TB diagnostic testing was 62.5 (IQR 33.5–70.5) days. Five (63%) missed opportunities

Table 2. Hospitalizations for 51 persons who might have experience TB diagnostic delay in a study of TB diagnostic delays and treatment outcomes among patients with COVID-19, California, USA, 2020*

Disease-associated hospitalization†	No. admissions	Median duration, d (IQR)	Range, d	Cumulative hospital days	ICU and intubation	In-hospital death‡
Total	73	12.0 (7.0–21.0)	1–139	1,324	14	6
TB only	35 (47.9)	13.0 (8.0–21.0)	1–74	634	5 (14.3)	0 (0.0)
TB and COVID-19§	23 (31.5)	10.0 (5.0–20.0)	1–139	392	5 (21.7)	4 (17.4)
COVID-19 only	15 (20.5)	12.0 (6.0–26.0)	3–68	298	4 (26.7)	2 (13.3)

*TB–COVID-19 co-infected patients had TB and COVID-19 diagnoses within 120 d of each other, whereby ≥1 of the diseases was diagnosed in 2020. Included California jurisdictions were Alameda, Los Angeles, Orange, Sacramento, San Diego, and Santa Clara Counties. Values are no. (%) except where indicated. ICU, intensive care unit; TB, tuberculosis.
†Based on the timing of hospitalization and diagnosis for each disease. Distinct TB-associated and COVID-19–associated hospitalizations must have occurred >14 d apart. Persons who were hospitalized at any point had an average 1.3 hospitalizations each.
‡Patients who died in hospital had admission durations of 10–57 d.
§Concurrent TB and COVID-19 were addressed in same hospital stay.

occurred during periods of elevated COVID-19 incidence, and 4 (50%) patients had COVID-19 testing (2 COVID-19–negative and 2 COVID-19–positive) instead of TB testing at the clinical encounter where the missed opportunity occurred (Figure 2).

Among the 58 patients, 51 (88%) were hospitalized ≥1 time (Table 2). Among 73 hospitalizations (average 1.3 per person), 35 (48%) were related to TB disease alone, 23 (32%) to indistinct (i.e., concurrent) TB and COVID-19 disease episodes, and 15 (21%) to COVID-19 alone. All 6 in-hospital deaths occurred during COVID-19–associated hospitalizations. The median overall hospital stay was 12 (IQR 7–21) days and was similar across all 3 disease-associated hospitalizations, even when we excluded in-hospital deaths.

Two patients did not start TB treatment because they died before TB diagnosis. Of the remaining 56 patients, 42 (75%) completed TB treatment within 12 months, 5 (9%) completed treatment in ≥12 months (including 1 case with rifampin resistance), 1 refused treatment, and 8 (14%) died before completing treatment. Overall, 10 (17%) patients died. Local TB programs determined that 3 (30%) deaths were definitely related to TB, 5 (50%) were possibly related, and 2 (20%) were probably not related. Of the 8 deaths definitely or possibly related to TB, 3 (38%) had TB and COVID-19 listed as contributors on the death certificate, 4 (50%) had only COVID-19, and 1 (16%) had neither term listed.

Conclusions

Delays in TB diagnosis or documentation of a missed opportunity to diagnose TB were more frequent during periods of elevated COVID-19 incidence, potentially because of pandemic-related staff and health system disruptions and community transmission mitigation policies (*6*,*7*). Approximately 1 in 6 persons in our sample had a documented clinical encounter where TB diagnostic evaluations could have been initiated earlier, which was consistent with literature published before the pandemic (*8*). Delayed diagnosis could lead to increased TB transmission and worse TB outcomes; in this analysis, delayed diagnosis appeared to be associated with more advanced TB, suggesting more infectiousness.

In our sample, 83% of patients had >1 TB-related hospitalization, which is higher than the prepandemic frequency of TB-associated hospitalization in California, which previously was reported as ≈50% (*9*). This finding might have been influenced by the slightly older age distribution of this patient cohort (median 57.5 [IQR 42–76] years) compared with pre-pandemic TB patients (median 56.0 IQR 35–70 [years]) in California from 2017–2019 (*5*). The median duration of TB-related hospital stays did not change compared with historical TB hospitalizations in California (*9*).

TB treatment completion appeared consistent with the pre–COVID-19 era in which ≈75% of patients completed TB treatment within 12 months (*10*). As we previously described, the proportion of deaths among TB patients with COVID-19 was higher than for TB patients in the recent pre-pandemic period (*5*). Most (77%) deaths were definitely or possibly TB-related but TB attribution on death certificates had poor correlation with detailed retrospective review, as has also been historically described (*11*). Thus, death certificates are unlikely to yield accurate estimates for deaths related to TB and COVID-19 co-infections.

Limitations of this study include use of observational data and lack of a comparison cohort of persons with TB who did not have COVID-19 in 2020 but had the same detailed clinical data. Our small sample size also precluded robust subgroup comparisons. The 6 participating TB programs represented 55% of California's population (*12*), 53% of reported COVID-19 (*13*), and 66% of the state's reported TB in 2020 (*1*). Nonetheless, our findings may not be generalizable to all areas of California or to other US regions.

In summary, delays in TB diagnoses continued to occur and the frequency of TB-related hospitalizations was higher for patients diagnosed with both TB and COVID-19 during the pandemic than historically observed in California. Nonetheless, the proportion of TB patients with COVID-19 completing treatment within 12 months was similar to persons with TB in the prepandemic period, suggesting TB programs managed to maintain TB treatment standards despite redirection of staff and resources. Pursuing a diagnostic workup for persons at risk of developing TB disease, even when a viral respiratory pathogen is widely circulating, remains critical for reducing TB-related illness in California.

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Appendix

Detailed Methods and Findings

Approvals

The California Department of Public Health, Centers for Disease Control and Prevention, and participating local health departments reviewed and approved this activity. This study was conducted consistent with applicable federal and Centers for Disease Control and Prevention policies, such as 45 CFR part 46, 21 CFR part 56, 42 USC §241[d]; 5 USC §552a; and 44USC §3501 et seq.

Description of Analysis Population

All 58 COVID-19 cases were SARS-CoV-2 PCR-confirmed. The median age was 57.5 (IQR 42.0–76.0, range 3.0–95.0) years and 22 (38%) were female (Appendix Table). Thirty-three (57%) were Hispanic or Latino, 18 (31%) were non-Hispanic Asian or Pacific Islander, 4 (7%) were non-Hispanic Black, and 3 (5%) were non-Hispanic White. Fifty-one (88%) of the 58 were born outside the United States, and 22 (38%) lived in the least advantaged quartile of census tracts based on the Healthy Places Index 3.0 (*1*). The majority (37, 66%) had a non-English primary language, 14 (25%) were essential workers, and 10 (19%) had no health insurance. There were 51 (88%) with only pulmonary or pleural TB and 33 (57%) with two or more comorbidities.

Timing of TB and COVID-19 Diagnoses

The TB diagnosis date was the earliest recorded among the dates of notification to the local health jurisdiction, treatment start, or specimen collection of a positive culture or nucleic

acid amplification test (NAAT). The COVID-19 diagnosis date was the specimen collection date for the earliest positive PCR result.

We considered disease episodes distinct if each episode was associated with TB or COVID-19 symptoms and a new diagnosis of TB or COVID-19 separated by ≥14 days whereby symptoms improved between the initial and subsequent episodes. Otherwise, we classified disease episodes as indistinct or having ≥1 asymptomatic episode. We defined asymptomatic COVID-19 as a positive COVID-19 PCR or antigen test in a person without COVID-19 symptoms that occurred ≥14 days from the TB diagnosis date.

Among 25 patients with two distinct disease episodes, TB was diagnosed first for 19 (76%), with a median of 88.0 days before COVID-19 diagnosis (IQR 73.0–100.0). COVID-19 was diagnosed first for 6 (24%), with a median of 61.5 days (IQR 27.0–73.0 days) before TB diagnosis. Almost half (25, 43%) had two distinct disease episodes, 21 (36%) had indistinct disease episodes, and the remaining 12 (21%) had ≥1 diagnosis where symptoms were absent or unknown. Asymptomatic, PCR-confirmed COVID-19 occurred in 7 (12%) TB/COVID-19 patients and another 5 (9%) TB/COVID-19 patients had insufficient information available to determine COVID-19 symptom status.

Recent Transmission

We conservatively defined TB/COVID-19 patients as recently infected with Mtb if 1) the patient's TB isolate was within five single nucleotide polymorphisms of another patient's isolate and, 2) the patients were diagnosed <3 years apart or had epidemiologic links. Several TB/COVID-19 patients (9 of 49 with known genotype; 18%) may have acquired Mtb infection recently.

Missed Opportunities and TB Diagnostic Delays

COVID-19 and TB are primarily respiratory diseases that can be difficult to distinguish clinically. However, in addition to epidemiologic risk factors and time course of clinical presentation, there are key symptom profiles of (*2*) prolonged cough, hemoptysis, weight loss, and radiographic features (i.e., cavities, tree-in-bud pattern, pleural effusion, pulmonary nodules, upper lobe infiltrates) that should prompt clinicians to consider pulmonary TB (*3–5*), regardless of COVID-19 status, to avoid delays in TB diagnoses during the COVID-19 pandemic. We defined a missed opportunity to diagnose TB as a documented clinical encounter for a person

with TB risk factors (i.e., non-U.S.-born, correctional facility resident, homeless, or HIV-positive) for which the relative specificity of symptoms or imaging could have led an experienced clinician to consider TB. The clinical encounter 1) must have occurred without acid fast bacilli (AFB) smear or Mtb NAAT submission and 2) must have been associated with ≥1 symptom (i.e., hemoptysis, weight loss or cough ≥3 weeks) or ≥1 chest imaging feature (i.e., cavity, tree in bud pattern, pleural effusions, nodules, miliary, or upper lobe infiltrate) more specific for TB than COVID-19 pneumonia.

We defined delays in TB care using dates of symptom onset, first clinical consultation for TB-related symptoms, and TB treatment start. A diagnostic delay was >30 days between TB symptom onset and first clinical consultation for TB-related symptoms and a treatment delay was >30 days between first clinical consultation for TB-related symptoms and TB treatment start.

Hospitalizations

We calculated the hospitalization duration as the sum of overnight stays. We classified hospitalizations as TB-associated, COVID-19-associated, or both TB- and COVID-19-associated based on the timing of hospitalization and diagnosis for each disease. Distinct TB-associated and COVID-19-associated hospitalizations must have occurred >14 days apart.

Elevated COVID-19 Incidence

We used the statewide 7-day average COVID-19 incidence rate of ≥15 cases per 100,000 population to define elevated COVID-19 incidence (*6*). We considered the periods above this threshold (i.e., 6/21/2020–8/8/2020 and 11/4/2020–2/14/2021) to be elevated COVID-19 incidence and designated other dates as non-elevated COVID-19 incidence.

TB Progression with COVID-19

T-cell subset and cytokine profile alterations in SARS-CoV-2 infection may create a host environment favorable for TB progression (*7*,*8*). Additionally, some COVID-19 directed therapies target immune pathways critical to the host immune response to *Mycobacterium tuberculosis* (Mtb) (*9*). Speculative case reports of TB reactivation caused by COVID-19 or its treatments have been published (*10–12*). We designated use of immunomodulating treatment (i.e., systemic corticosteroids, IL-1 inhibitors, IL-6 inhibitors, anti-IL-6 monoclonal antibodies, or kinase inhibitors) for symptomatic COVID-19 patients if the use occurred ≥14 days before their TB diagnosis date (*9*).

Four of 58 (7%) TB/COVID-19 patients potentially had COVID-19-related TB progression, where the onset of TB disease was ≥14 days after COVID-19 and there were no TB-specific imaging results or symptoms at the time of COVID-19 diagnosis. At least 3 (75%) of these patients received immunomodulating COVID-19 therapies: one patient started high dose dexamethasone 89 days before TB symptom onset, a second received tocilizumab only (93 days), and the third received hydroxychloroquine (29 days) plus tocilizumab (22 days).

Outcomes and Deaths

We used the following table, developed by California TB experts, to standardize TB/COVID-19 patient deaths as definitely, possibly, probably not, or definitely not attributable to TB.

Categorization scheme for TB-relatedness of deaths

Category A: Definitely TB-related

A1: Died of complications of pulmonary and/or pleural TB including:

- Respiratory failure associated with extensive TB disease
- Massive pulmonary hemorrhage immediately before death
- Extensive pulmonary destruction, with or without cavitations
- Tension pneumothorax, or

A2: Died of specific consequences related to site of extra-pulmonary TB disease including:

- CNS TB: brain herniation or comatose state
- Disseminated disease (defined as >2 sites of TB disease) with sequelae (e.g., bacteremia)
- Pericardial TB: cardiac failure, myocarditis, or cardiac tamponade
- GI TB: bowel perforation or hemorrhage
- Renal TB: renal failure
- Peritoneal TB: disseminated TB disease, or bowel obstruction

- Any other situation in which death is due to specific consequences related to site of extrapulmonary TB disease, or

A3: Died of adverse event associated with TB medication, or

A4: Periprocedural death (<30 days after procedure) in which the primary indication for procedure was treatment for TB or to establish a diagnosis of TB, or in which TB complicated the procedure and contributed significantly to the outcome.

Category B: Possibly TB-related

B1: Sufficient and well-documented evidence for more than one cause of death is present, including sufficient evidence for TB as a cause of death, or

B2: Sufficient and well-documented evidence for a cause of death other than TB is present, and TB possibly contributed to death, or

B3: Sufficient and well-documented evidence for a cause of death other than TB is present and TB medication possibly exacerbated this underlying condition, or

B4: No other cause of death except TB, and TB is a likely cause of death, or

B5: Died of drug interactions between TB medications and other medications.

Category C: Probably not TB-related

C1: Sufficient and well-documented evidence for a cause of death other than TB is present, and TB did not contribute significantly to death.

Category D: Definitely not TB-related

D1: Death due to unnatural causes, or

D2: Periprocedural death in which the primary indication was a medical condition other than TB and TB did not complicate procedure or contribute significantly to the outcome, or

D3: Sufficient and well-documented cause of death other than TB is present, and TB definitely did not contribute to death, or

D4: Site of TB disease typically does not contribute significantly to death

Category E: Unknown TB-related

E1: There is no sufficient and well-documented evidence for a cause of death other than TB, and TB did not contribute significantly to death, or

E2: Unable to evaluate extent of TB disease.

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Appendix Table. Characteristics of 58 TB/COVID patients, six high-burden jurisdictions, California, 2020*

Demographics and risk factors	No. (%)
Median age, y (IQR)	57.5 (42.0–76.0)
Sex	
M	36 (62.1)
F	22 (37.9)
Race/ethnicity	
Non-Hispanic Asian or Pacific Islander	18 (31.0)
Non-Hispanic Black	4 (6.9)
Hispanic or Latino	33 (56.9)
Non-Hispanic White	3 (5.2)
Born outside the United States	51 (87.9)
Median years in United States before TB diagnosis (IQR)	24.7 (19.2–31.9)
Healthy Places Index score†	
4th quartile, most advantaged	4 (6.9)
3rd quartile	10 (17.2)
2nd quartile	22 (37.9)
1st quartile, least advantaged	22 (37.9)
Primary language non-English, n = 56	37 (66.1)
No health insurance, n = 53	10 (18.9)
Essential worker‡	14 (24.6)
Diagnosed in correctional facility	2 (3.5)
Diagnosed in long-term care facility	5 (8.6)
Homeless in past year	2 (3.5)
Substance misuse, n = 56§	6 (10.7)
Recent secondary case among cases with genotype, n = 49¶	9 (18.3)
Underlying conditions	
Diabetes	34 (58.6)
Cardiovascular disease/hypertension/stroke	26 (44.8)
Current/former smoker or e-cigarette/vape user	11 (19.0)
Chronic kidney disease	9 (15.5)
HIV/other immunocompromised#	8 (13.8)
Chronic lung disease	8 (13.8)
Chronic liver disease	6 (10.3)
Malnourishment	5 (8.6)
Obesity	5 (8.6)
≥2 medical risk factors	33 (56.9)
Clinical characteristics	
Any initial isoniazid or rifampin resistance, n = 50	2 (4.0)
Site of TB disease	
Extrapulmonary only	7 (12.1)
All Pulmonary/pleural	51 (87.9)

Demographics and risk factors	No. (%)
Smear positive, n = 45	26 (57.8)
Cavitary disease**	18 (35.3)
Disseminated TB disease††	6 (10.3)
Asymptomatic COVID-19 diagnosis	7 (12.1)
Potentially healthcare-associated COVID-19	13 (22.4)
No. days between TB and COVID-19 diagnoses	
0–14 d	13 (22.4)
15–30 d	8 (13.8)
31–60 d	8 (13.8)
61–120 d	29 (50.0)
Order of disease episodes	
TB episode first	19 (32.8)
COVID-19 episode first	6 (10.3)
Indistinct disease episodes	21 (36.2)
≥1 disease asymptomatic/unknown symptoms	12 (20.7)
Potential TB progression after first COVID-19 diagnosis because of COVID-19 disease or treatment, n = 19	4 (21.1)
Immunomodulator used	3 (75.0)
No. hospitalizations	
0	7 (12.1)
1	31 (53,5)
2	18 (31.0)
3	2 (3.5)
Delays in TB diagnosis/treatment or missed TB diagnostic opportunity for pulmonary TB patients, n = 51	
Diagnostic delay	22 (43.1)
Median days between symptom onset to first clinical consultation for TB-related symptoms (IQR)	95.0 (60.0–117.0)
Treatment delay	9 (17.7)
Median days between first clinical consultation for TB-related symptoms to treatment start (IQR)	62.5 (45.5–92.5)
Had missed opportunity for pulmonary TB diagnosis	8 (15.7)
Diagnosed with COVID-19 during period of elevated COVID-19 incidence‡‡	38 (65.5)
Treatment outcomes among patients started treatment, n = 56	
Completed ≤12 mo	42 (75.0)
Completed >12 mo§§	5 (8.9)
Not completed	1 (1.8)
Died during treatment	8 (14.3)
No. deaths	10 (17.2)
Dead at diagnosis	2 (20.0)
Cause of death	
Definitely TB-related	3 (30.0)
Possibly TB-related	5 (50.0)
Probably not TB-related	2 (20.0)

*TB/COVID-19 patients were patients diagnosed within 120 d of each other whereby at least one of the diseases was diagnosed in 2020. Included California jurisdictions were Alameda, Los Angeles, Orange, Sacramento, San Diego, and Santa Clara Counties. TB, tuberculosis.
†The Healthy Places Index combines 25 community characteristics, like access to healthcare, housing, education, and more, into a single indexed score.
‡Work that must be done in person and in which the worker interacts with other workers or the public.
§Any illicit injection or noninjection drug use or excess alcohol consumption within the 12 mo. before TB diagnosis
¶Based on phylogenetic analysis (≤5 single nucleotide polymorphisms) and timing (<3 y) or epidemiologic link
#Includes persons taking immunosuppressing therapies (e.g., tumor necrosis factor α antagonist, high-dose steroid) or medical condition such as hematologic malignancy
**Cavity identified on chest x-ray or chest computed tomography among persons with pulmonary TB where imaging was performed
††Meningeal, miliary, positive acid-fast bacilli blood culture, or both pulmonary and extrapulmonary TB
‡‡California 7-d average incidence of new COVID-19 cases ≥15 cases per 100,000 population
§§One case had resistance to rifampin.