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Original Research Article

Tuberculosis diagnostic delay and its correlates among patients hospitalized during the COVID-19 pandemic period at a tertiary public hospital in Nairobi, Kenya

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ABSTRACT

Background: Tuberculosis (TB) diagnostic delay remains a core challenge in the achievement of effective TB prevention and control globally. A study was undertaken to determine TB diagnostic delay and its correlates among patients hospitalized during the COVID -19 pandemic period at a tertiary public hospital in Nairobi, Kenya
Methods: This was a cross sectional mixed parallel method study conducted at Kenyatta National Hospital. Quantitatively, hospitalized patients' records from January 2020 to December 2021 were abstracted while qualitatively in-depth telephone interviews were conducted on 36 discharged patients. Diagnostic delay was defined as time from admission until diagnosis (>5 days). Logistic regression was used to determine the factors associated with diagnostic delay while qualitative data was thematically organized using N-Vivo software version 12.
Results: A total of 563 (67.1%) delayed in being diagnosed for TB. Extrapulmonary TB (EPTB) aOR=4.108 (95% CI 2.782–6.067), and GeneXpert test aOR=6.306 (95% CI 3.763–10.568), p=0.000 were significantly associated with delayed TB diagnosis. On their pathway to final diagnosis, hospitalized patients encountered personal, private and lower public facilities' barriers during the COVID-19 period.
Conclusion: TB diagnostic delay worsened during the COVID-19 pandemic period. Effective utilization of TB dedicated diagnostic tools and efficient public private partnerships can reduce TB diagnostic delay in case of any future pandemics.

Keywords: Tuberculosis, Correlates, COVID-19

INTRODUCTION

TB though an ancient disease, still remains a significant public health problem and the sole cause of global mortality from a single infectious agent.[1,2] The disease is transmitted by *Mycobacterium tuberculosis* bacteria found in tiny droplets generated by infected individuals through laughing, coughing and sneezing.[3,4] Globally, approximately one quarter of the population is infected with *M. tuberculosis*.[5] Africa accounts for 24% of global incident cases (2.5 million) whereas sub-Saharan Africa contributes 29% of all the TB cases worldwide.[5] Based on the 2024 WHO global TB report, almost 10.8 million people developed TB in 2023, an increase from 10.7 million in 2022 and much higher than 10.4 million in 2021 and 10.1 million in 2020 hence led to the drastic negative effects in the global TB control progress.[2]

This upward trend reflects the ongoing after-effects of TB services disruptions during the COVID-19 pandemic period.[5] Out of the 140,000 people who developed TB in Kenya in 2020, only 72,943 were diagnosed and notified

meaning almost 50% of TB cases were either undiagnosed or unnotified. Nairobi County contributed just 9,804 (13%) (down from 15 %) to the national notifications.[4] Meanwhile, KNH that normally accounts for about 10% of the Nairobi County case notification nosedived to just 618 (3.4%) cases.[6,7] Early TB diagnosis enhances effective disease prevention and control both in the community and in the health care facilities.[8] Longer duration between symptom development and diagnosis increases TB-related morbidity and mortality.[3] In Kenya, TB cases identification is mainly passive where after symptoms development, patients visit health care facilities 3 leading to late diagnosis.[9]

The emergence of (COVID-19) in 2020, reversed the global TB control progress made previously leading to a massive decrease in newly diagnosed and notified TB cases and consequently pushing the global TB targets off track.[10] During the COVID-19 pandemic period, challenges such as unreliable transport as well as government movement restrictions could have contributed to delay in TB diagnosis.[11] Therefore, this study determined TB diagnostic delay and its correlates among patients hospitalized during the COVID-19 pandemic period at KNH in Nairobi, Kenya to contribute to the country's national policy in effective TB patient management in case of future public health emergencies.

METHODS

Study design, site, participants and sampling

This was a cross-sectional hospital-based mixed parallel study that involved TB records review and in-depth telephone interviews of TB patients after being discharged from hospital. Quantitative and qualitative data were simultaneously collected and analyzed separately. The study was conducted at KNH-a level six 1800 bed - capacity hospital in Nairobi County. The hospital has eight TB in-patient units that handle hospitalized TB cases, two TB laboratories (one for GeneXpert and the other for sputum smear microscopy tests) and a Radiology department for radiologic TB diagnostic tests.

The study participants were newly diagnosed adult TB patients hospitalized from January 2020 to December 2021. Purposive sampling was used to select the study site; census was used to select records of all adult TB patients. Incomplete records, <18 years, absconded patients and deaths were excluded. Qualitatively, simple random sampling was used to select IDI interviewees.

Data collection

Quantitatively, a refined Microsoft Excel 2016 spreadsheet was used to extract data from the adult inpatients' records including demographics, clinical characteristics, TB tests done, results turn - around time, date of admission and date of TB diagnosis. Qualitatively in-depth telephone interviews were conducted on 36 patients discharged home, randomly selected, orally consented to participate in the study and audio-recorded. The interviews included awareness of TB signs and symptoms, health facilities visited, barriers on the pathway to final TB diagnosis.

Data management and analysis

Quantitative data was coded, entered into excel spreadsheet and edited for errors before analysis using Stata software, version 15.0 as per the study objectives. Data summaries and generated frequencies on categorical variables were conducted using descriptive statistics and presented in text, tables and figures. Inferential analysis at 95% CI was used to check for possible association between independent and dependent variables. Diagnostic delay was defined as the duration between admission and diagnosis which was 5 days.

Only characteristics potentially associated with diagnostic delay (>5 days) were evaluated using logistic regression in both bivariate and multivariate. All variables with a p value≤0.25 in bivariate analysis were subjected to multivariate analysis to establish the factors that were independently associated with TB diagnostic delay. All variables with a $p<0.05$ were considered statistically significant. Qualitatively, in-depth interviews were transcribed and analyzed thematically.

A six-step process was used in analyzing the data (familiarization, coding, themes generation, themes review, defining and naming of the themes and documenting the data analysis. First the scripts were read and re-read to familiarize with initial codes and identify the relevant features. Codes were then collated into potential themes which were reviewed further before final themes were generated and identified in form of topics, ideas and patterns or repeated meaning.

A matrix on emerging themes was created against the patients' responses by use of N-Vivo software version 12. Data was analyzed by two researchers independently and interpretations of themes were shared and discussed to agree upon key themes that had emerged from the data to improve inter-rater reliability.

Ethical approval

Ethical approval was sought from the KNH/UoN Ethics and Research Committee (P657/08/2022), clearance from NACOSTI (P-23-27049) and permission from JKUAT post graduate school before the study was commenced. Participation in this study was voluntary and there were no incentives for participants. Thorough explanation on the aim and study purpose was done to the study participants before obtaining informed oral consent from them. Confidentiality was assured on all the information provided by restricting persons accessing the data.

RESULTS

Characteristics of patients hospitalized at KNH during the COVID -19 pandemic period

A total of 839 patients hospitalized during the study period were selected into the study of whom 258 (24.6%) were in 2020 and 581 (55.4%) in 2021.

About 494 (58.9%) were males, 580 (69.2%) aged between 18-44 years, 535 (63.8%) had normal BMI, 672 (80.1%), extra pulmonary TB (EPTB) of whom 327 (48.7%) had central nervous system TB (CNS TB, 394 (47%) were HIV positive and all of them were on cotrimoxazole preventive therapy and HAART) (Table 1).

Investigations used in final TB diagnosis during the COVID -19 pandemic period

A total of 796 (94.9%) patients were diagnosed using radiologic tests (X-ray, U/S, CT scan or MRI). Out of 36 patients eligible for GeneXpert test in 2020, only 14 (38.9%) were diagnosed (Table 2).

Factors associated with TB diagnostic delay during the pandemic period

A total of 563 (67.1%) delayed. EPTB was significantly associated with TB diagnostic delay aOR=4.108 (95% CI 2.782–6.067), p–0.000. Conversely, CNS TB was significantly protective against TB diagnostic delay aOR=0.243 (95% CI 0.165–0.359), p–0.000 compared to other forms of EPTB. Nonuse of radiologic tests aOR=6.521 (95% CI 1.519–27.996), p–0.012 and use of GeneXpert test aOR=6.306 (95% CI 3.763–10.568), p–0.000 were significantly associated with TB diagnostic delay (Table 3).

Barriers on the patients' pathway to final TB diagnosis

Personal/patient (restricted movement, fear testing positive for COVI-19, fear of forceful isolation if tested positive for COVID-19 and low awareness on TB symptoms) were the identified barriers to final diagnosis. Private (multiple visits to the same facility) and public facilities (conversion of public facilities to COVID-19 centers and long test result TAT) contributed to TB diagnostic delay (Table 4).

Table 1: Characteristics of patients hospitalized at KNH during the pandemic period.

Variable	Overall (n=839, 100.0%)	2020 (n=258, 24.6%)	2021 (n=581, 55.4%)
	N (%)	N (%)	N (%)
Gender			
Male	494 (58.9)	154 (59.7)	340 (58.5)
Female	345 (41.1)	104 (40.3)	241 (41.4)
Age (in years)			
18-25	124 (14.8)	36 (14.0)	88 (15.1)
26-35	243 (29.0)	74 (28.7)	169 (29.1)
36-44	213 (25.4)	80 (31.0)	133 (22.9)
45-54	149 (17.8)	42 (16.3)	107 (18.4)
>55	110 (13.0)	26 (10.0)	84 (14.5)
BMI			
Underweight	162 (19.3)	55 (21.3)	107 (18.4)
Normal	535 (63.8)	167 (64.7)	368 (63.3)
Overweight	113 (13.4)	27 (10.5)	86 (13.3)
Obese	29 (3.5)	9 (3.5)	20 (3.4)
Type of TB			
P	167 (19.9)	36 (14.0)	131 (22.5)
EP	672 (80.1)	222 (86.0)	450 (77.4)
EPTB sub type (n=672)			
CNS	327 (48.7)	114 (44.2)	213 (57.3)
Pleural effusion	135 (20.0)	41 (23.8)	94 (54.7)
Disseminated TB	45 (6.7)	19 (33.3)	26 (45.6)
Peritonitis	36 (5.4)	8 (15.4)	28 (53.8)
Milliary	26 (3.9)	18 (42.9)	8 (19.0)
Others	26 (3.9)	6 (14.3)	20 (47.6)
Pericarditis	40 (6.0)	8 (19.5)	32 (78.0)
Bone	30 (4.4)	7 (23.3)	23 (76.7)

Continued.

Variable	Overall (n=839, 100.0%)	2020 (n=258, 24.6%)	2021 (n=581, 55.4%)
	N (%)	N (%)	N (%)
Spine	7 (1.0)	1 (4.2)	6 (25.0)
HIV status			
Positive	394 (47.0)	128 (49.6)	266 (45.8)
Negative	442 (52.7)	128 (49.6)	314 (54.0)
Not done	3 (0.3)	2 (0.8)	1 (0.2)
CPT			
Yes	394 (100.0)	128 (100.0)	266 (100.0)
No	0 (0.0)	0 (0.0)	0 (0.0)
ART			
Yes	394 (100.0)	128 (100.0)	266 (100.0)
No	0 (0.0)	0 (0.0)	0 (0.0)

Table 2: The tests used in TB diagnosis during the pandemic period.

Variable	Overall N (%)	2020 N (%)	2021 N (%)
TB tests done			
***Radiologic tests (n=839)**			
Yes	796 (94.9)	215 (83.3)	581 (100.0)
No	43 (5.1)	43 (16.7)	0 (0.0)
GeneXpert (n=167)			
Yes	144 (86.2)	14 (38.9)	130 (99.2)
No	23 (13.8)	22 (61.1)	1 (8.0)

*Radiologic tests – X-ray, Ultra sound, CT scan and MRI

Table 3: Factors associated with TB diagnostic delay during the pandemic period.

Variable	Delay		Bivariate analysis		Multivariate analysis	
	≤5 days n=276 (32.9%)	> 5days n=563 (67.1%)				
	N %	N %	cOR (95% CI)	P value	aOR (95%CI)	P value
Age (in years)						
≤45	191 (22.8)	409 (48.7)	1.058 (0.949-1.180)	0.299	–	
>45	85 (10.1)	154 (18.4)				
Sex						
Female	126 (15.0)	219 (26.1)				
Male	150 (17.9)	344 (41.0)	0.203 (0.159–0.992)	0.062	0.661 (0.458-0.953)	0.127
BMI						
≤18	112 (13.3)	50 (6.0)				
>18	451 (53.8)	226 (26.9)	1.122 (0.776–1.624)	0.54	–	
HIV status (n=836)						
Positive	129 (15.4)	265 (31.7)				
Negative	147 (17.6)	295 (35.3)	1.016 (0.837–1.233)	0.874	–	
Type of TB						
P	101 (12.0)	66 (7.9)				
EP	175 (20.9)	497 (59.2)	1.871 (1.543–2.270)	0	4.108 (2.782–6.067)	0
EPTB sub type (n=672)						
CNS	44 (6.5)	283 (42.1)	0.395 (0.271–0.531)	0	0.243 (0.165–0.359)	0
*Others	131 (19.6)	214 (31.8)				
Tests done						
****Radiologic tests**						
Yes	274 (32.7)	522 (62.2)				
No	2 (0.2)	41 (4.9)	7.401 (1.906–28.74)	0	6.521 (1.519 –27.996)	0.012

Continued.

Variable	Delay		Bivariate analysis	Multivariate analysis		
	≤5 days n=276 (32.9%)	> 5days n=563 (67.1%)				
	N %	N %	cOR (95% CI)	P value	aOR (95%CI)	P value
GeneXpert test (n=167)	<1 day	>1 day				
Yes	35 (21.0)	109 (65.3)	4.793 (1.738–8.852)	0	6.306 (3.763–10.568)	0
No	0 (0.0)	23 (13.7)				

*others–pleural effusion, pericarditis, disseminated, peritonitis, milliary, bone, spine, eye, tongue, skin, testes, vulva, ovaries,
**Radiologic tests–X-ray, ultrasound, CT scan and MRI

Table 4: Barriers on the patients' pathway to final TB diagnosis.

Themes	Subthemes	Significant responses
Personal barriers	Low awareness of TB symptoms Restricted movement Fear of forced isolation if found with COVID - 19	*"I thought this was just a normal flu or"* (D20-48M). *"Because I take medicine for asthma……So, I bought medicine from the chemist severally but I got worse instead" .....I did not think about TB"* (D18-30M). *"……It was announced that no movement to anywhere……everything was at a standstill……I made concoctions from herbs and drunk…."* D10-34F. *"You know at this time everyone was fearing COVID - 19 because it was killing old people ……anyone found with COVID was forcefully isolated…."* (D4-46F). *"……I feared quarantine and being locked there like an animal…. I bought medicines for cough because I did not want to be isolated by force"* (D14-21M).
Private facilities barriers	Multiple visits to same private facility Unable to make a TB diagnosis Unwilling to refer	*"After going back to the private clinic nearby for about 4 times and no help, I went to the referral hospital"* (D4 - 37). *"These doctors private have a way of attracting you……a lot of big machines doing several expensive tests but not TB"* (D14-21M). *"I went back to the same doctor in a large private hospital who treated me for about 5 months……I requested to be sent for further care but he did not want ….my children took me to the referral hospital"* (D33 – 64M).
Public facilities barriers	Conversion of some of the lower public facilities to COVID-19 centers Long TB result waiting time	*"Some of the public health centers were closed ……no disease was treated there other than COVID…. I went back home then to KNH…."* (D22 – 36M). *"Very many people were getting COVID and being taken to the government hospital and locked there……The gate was only opened for people with that bad disease* (D32-34M). *"…. I waited for a long time for my result…..it took about 2 weeks for my test results to be ready"* (D15-37M).

DISCUSSION

Majority of patients in this study were aged between 18–44 years, which concurs with findings from a similar study in Kenya as well as the 2016 national prevalence survey 15 where TB was found to be common between 18 to 50 years.[14] Despite documented evidence that low BMI is associated with TB, most patients in this study had a normal BMI. This could be due to minimal impact of EPTB on appetite and metabolism.[14,16] Having >2/3 of patients hospitalized during the pandemic period delay in getting a TB diagnosis concurs with WHO predictions that due to disruptions of TB services by the COVID-19 pandemic leading to increased diagnostic delay, underdiagnosis and TB-related mortality.[2] Furthermore, government movement restrictions and conversion of lower public facilities to COVID-19 centers forced patients to either visit private or tertiary facilities thus worsening the diagnostic delay.[17] In this study, EPTB was significantly associated with TB diagnostic delay probably due to inaccessibility and the paucibacillary of the affected sites as well as lack of universal standardized and efficient EPTB sample processing techniques hence delaying the diagnostic process.[18–20] Inversely, CNS TB was protective against delayed diagnosis contrary to similar studies from other high TB-burden countries (China, India and Indonesia) where patients with CNS TB were more likely to have a delayed diagnosis due to hesitancy of clinicians to perform TBM diagnostic procedures like lumbar punctures and low sensitivity of these diagnostic tests on EPTB.[21,22] The difference in these findings could be due to diverse study designs, TB control models, regional and facility-specific diagnostic guidelines and probably clinicians in our study site

relying on clinical rather than microbiological confirmatory diagnosis hence reducing diagnostic delay. Despite being the gold standard in TB diagnosis due to its sensitivity, quick and simultaneous rifampicin resistance detection, in this study, GeneXpert test was significantly associated with TB diagnostic delay.[21] This is also contrary to other similar studies which revealed that GeneXpert test exponentially improved. TB and rifampicin resistance detection thereby promoting TB control and improving patient outcomes.[17,23,24] The delay in this study could be explained by the fact that laboratory staff handling sputum samples in the study site feared contracting COVID-19 thereby delaying the sample processing and release of results.[7]

On their way to final diagnosis, a substantial number of patients in this study made multiple visits to private facilities without being diagnosed while others were treated severally in the same private facilities for non-TB conditions without referral to other facilities. Previous studies have documented reluctance of private practitioners to refer TB patients as a challenge in TB care and management.[9,14] Therefore, effective use of standardized diagnostic protocols and procedures can enhance early TB diagnosis. Long test result waiting time and conversion of public facilities to COVID-19 centers were also some of the barriers identified in public health facilities during the COVID-19 period.

This concurs with the 2020 Kenya national TB program report which indicated that conversion of some health care facilities to COVID-19 solation centres impacted negatively on diagnosis and follow up of patients in those facilities.[7] This led to staff shortage 3 relocation of staff to COVID-19 centers culminating to long waiting times in health facilities.[25] In this regard, ensuring availability of adequate resources, minimal disruption of existing services as well as effective collaboration between the public and the private sector in TB diagnosis and management could prevent any possible future disruptions and improve TB service delivery while minimizing delays in case of future pandemics.[14]

Limitations

Using retrospective data collection in the quantitative arm could have higher likelihood of incomplete or missing data. Additionally, in a cross-sectional study, it becomes difficult to make causal inferences besides providing contrary findings had another timeframe been used.

CONCLUSION

As much as hospitalization is supposed to favor prompt TB diagnosis, reduce HCF disease transmission risks, improve patient outcomes and HC system efficiency, TB diagnostic delay worsened among patients hospitalized in KNH during the COVID-19 period. Moreover, EPTB, nonuser of diagnostic radiologic and use of GeneXpert tests were significantly associated with delay. Furthermore, personal, private and lower public facilities' barriers contributed to final diagnosis. The health authorities need to promote effective public private partnerships in TB management & control during future pandemics. Further studies should be conducted to establish why high rates of EPTB in this study site.

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