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Impact of the COVID-19 pandemic on tuberculosis services in a rural area of Senegal

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SUMMARY

Background: The Coronavirus (COVID-19) pandemic significantly impacted on tuberculosis (TB) services (TB) services in both high and low TB burden countries. Objectives: This study aimed to investigate the impact of COVID-19 on TB outpatient services in terms of new TB case notifications and treatment outcomes in a rural area of Senegal.
Methods: A retrospective observational study was conducted at the Health Care Centre of Diofior (HCD) in the Fimela district, Fatick Region (Senegal), covering the period from January 1st, 2018, to December 31st, 2022. Data were divided into pre-COVID-19 (until March 31st, 2020) and during-COVID-19 (from April 1st, 2020) periods for analysis.
Results: Among the 246 TB cases included (63.4% male, median age 38.4 years), 94 (38.2%) had been diagnosed in the pre-COVID-19 period and 152 (61.8%) in the during-COVID-19 period. In 2020, TB case notifications dropped by 24.4% compared to 2019, followed by an increase of 70.6% in 2021 and 91.2% in 2022. The TB treatment success rate decreased from 85.1% before COVID-19 to 77.6% in during-COVID-19 period. Moreover, mortality increased from 2.1% to 5.3%, and the lost-to-follow-up rate rose from 8.5% to 14.5% between the pre- and during-COVID-19 periods.
Conclusions: Although the number of COVID-19 cases reported in Senegal was relatively low in the study period compared to other settings, our study indicates that the pandemic had a significant impact on TB services in this rural area of Senegal.

Keywords: tuberculosis; COVID-19; case notification; treatment outcome; Senegal.

INTRODUCTION

According to the World Health Organization (WHO) Global Tuberculosis (TB) Report 2024 the Coronavirus disease (COVID-19) pandemic significantly impacted on TB services in both high and low TB burden countries [1]. In 2020, a widespread decline of new TB case notifications was recorded worldwide. TB incidence and mortality

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increased in 2020 and 2021. Nevertheless, African countries appeared to be less affected by the COVID-19 pandemic compared to industrialized countries, showing a less significant drop in TB notifications. However, limited data are available from sub-Saharan Africa, and even less for rural areas of African countries [2, 3]. A recent review highlighted the heterogeneous impact of the COVID-19 pandemic on both communicable and non-communicable diseases across Africa, with particular concerns regarding service disruption in low-resource settings [4].

Senegal is a high TB incidence country, with an estimated incidence rate of 110 (76-150) cases per 100,000 population in 2023, with an estimated total TB incidence of 20,000 (14,000-27,000) cases, according to latest WHO report. The estimated Human Immunodeficiency Virus (HIV)-negative TB mortality rate is 10 (6-15) cases per 100,000 population, while the estimated HIV-positive TB mortality rate is 0.87 (0.57-1.2) cases per 100,000 population in 2023 [1]. Senegal reported relatively few COVID-19 cases and deaths: from January 2020 to June 2023, 89,003 confirmed cases and 1,971 deaths were reported to WHO [5].

Health services in Senegal are organized at different levels: the country is divided in 14 health regions, 79 health districts, 40 hospitals, 107 health centres and 1584 health posts [6].

Since 2013, the Italian non-for-profit organization StopTB Italia ODV has been supporting the Senegalese National Tuberculosis Programme (NTP) by delivering TB awareness campaigns, providing efficient diagnostic tools, offering treatment consultations and economic support to TB patients at the Health Centre of Diofior (HCD). This center serves the Fimela district, an administrative area in the Fatick region located in the Southwest part of Senegal's Northern outcrop. The district has an estimated population of 80,599 people, mostly farmers, fishermen and merchants living in rural and suburban settings organized into villages. The multifaceted intervention provided by StopTB Italia ODV significantly improved TB treatment outcomes, especially for TB/HIV co-infected patients [7].

The aim of this study was to investigate the impact of the COVID-19 pandemic on TB outpatient services in the Fimela district, Senegal, by comparing the volume of new TB cases notified before and after the start of COVID-19 pandemic in the region and their treatment outcomes.

MATERIALS AND METHODS

Study design

This observational, retrospective, single-center study was conducted at the TB outpatient clinic of HCD from January 2018 to December 2022. Data were collected from TB case registers at HCD and analyzed by stratifying them into two periods: pre-COVID-19 (January 1st, 2018, to March 31st, 2020), and during-COVID-19 (April 1st, 2020, to December 31st, 2022). The cut-off date of March 31st, 2020 was chosen as the COVID-19 restrictions in Senegal like national curfew and subsequent movement restriction between regions including Diofior started at the end of March 2020. All TB cases that received TB therapy during this period were included in the study. The study was endorsed by the NTP.

Study procedures

TB case finding in Fimela district is implemented through passive and active case finding. Active TB case finding in the Fimela district is conducted by women (badieu'ngox) trained by StopTB Italia ODV. These women identify individuals with symptoms suggestive of TB (e.g., productive cough, fever, weight loss, and night sweats), through door to door and outreach activities. All presumptive TB cases are referred to the TB outpatient clinic at HCD, where a sputum sample is collected for smear microscopy. If the smear microscopy results turn out negative, presumptive TB cases are tested with Xpert MTB/RIF. Due to laboratory limitations, culture testing is not performed. A chest X-ray (CXR) is performed if both smear microscopy and Xpert MTB/RIF are negative. All individuals diagnosed with TB are offered an HIV test, and those who test positive are linked to outpatient HIV care. Additionally, blood glucose testing is performed. Once anti-TB treatment is initiated, patients undergo follow-up visits at the second, fifth, and sixth months of treatment, during which sputum smear microscopy is repeated. To ensure good adherence to treatment, Directly Observed Therapy (DOT) is offered by the badieu'ngox through regular patients' home visit whenever needed. To maximize retention in care, financial support of 20,000 Francs of the French Community of Africa (FCFA ≈ US$30-40) is provided by StopTB Italia ODV to patients once they achieve the end of anti-TB treatment (minimal wage is less

or equal to 1 US per day). This support is funded by profits generated from an agricultural cooperative run by former TB patients under the supervision of StopTB Italia ODV.
During the COVID-19 pandemic, outpatient clinics and outreach interventions through the badieu'ngox maintained their activities, although daily attendance decreased. Data were extracted from individual clinical records and from TB registers at HCD.

Statistical analysis
A descriptive data analysis was performed. Qualitative variables were described as absolute and relative (percentage) frequencies, whereas quantitative variables were summarized with mean (standard deviations, SD) or median (interquartile ranges, IQR) in case of parametric and non-parametric distribution, respectively. Between-group comparisons for qualitative variables were evaluated using the Chi-squared or Fisher exact tests. For quantitative variables, parametric distributions were assessed using the Student-t test, while non-parametric distributions were analyzed using the Mann-Whitney test. STATA version 17 (StataCorp, TX) was used to perform statistical computations.

Table 1 - Study population characteristics (PTB=pulmonary TB; EPTB=extrapulmonary TB; MTB=Mycobacterium tuberculosis, RIF= rifampicin; TB=tuberculosis).

		Total (n= 246)	*Pre-COVID-19 (n= 94)*	*During-COVID-19 (n= 152)*	*p-value (p<0.05)*
Male, n (%)		156 (63.4)	58 (61.7)	98 (64.5)	0.68
Median age, years (range)		35.5 (25-50)	39.5 (27-54)	33 (23.5-48.5)	0.08
Positive HIV test (n=228), n (%)		16 (7.0)	5/92 (5.4)	11/136 (8.1)	0.44
Abnormal blood glucose levels (n=214), n (%)		13/214 (6.1)	7/89 (7.9)	6/125 (4.8)	0.36
PTB, n (%)		234 (95.1)	87 (92.6)	147 (96.7)	0.14
EPTB, n (%)	No	234 (95.1)	87 (92.6)	147 (96.7)	0.14
	Lymph node	9 (3.7)	4 (4.3)	5 (3.3)	
	Pleural	2 (0.8)	2 (2.1)	0 (0.0)	
	Peritoneal	1 (0.4)	1 (1.1)	0 (0.0)	
Sputum smear microscopy, n (%)	+	55 (24.3)	13 (15.1)	42 (30.0)	*0.03*
	++	48 (21.2)	20 (23.3)	28 (20.0)	
	+++	96 (42.5)	38 (44.2)	58 (41.4)	
Positive Xpert MTB/RIF (n=38), n (%)		34/38 (89.5)	14/18 (77.8)	20/20 (100.0)	*0.04*
Chest X ray (n=60), n (%)	Not suggestive of TB	45/60 (75.0)	20/26 (76.9)	25/34 (73.5)	0.76
	Suggestive of TB	15/60 (25.0)	6/26 (23.1)	9/34 (26.5)	
Previous TB therapy, n (%)		13 (5.4)	9 (9.9)	4 (2.7)	*0.04*
Regimen, n (%)	2RHZE/4RH	243 (98.8)	91 (96.8)	152 (100.0)	0.06
	SRHZE	3 (1.2)	3 (3.2)	0 (0.0)	
Median (IQR) treatment duration, months		6 (6-6)	6 (6-6)	6 (6-6)	0.61
Outcome, n (%)	Treatment success	198 (80.5)	80 (85.1)	118 (77.6)	0.38
	Death	10 (4.1)	2 (2.1)	8 (5.3)	
	Treatment failure	4 (1.6)	2 (2.1)	2 (1.3)	
	Transferred out	4 (1.6)	2 (2.1)	2 (1.3)	
	Lost to follow up	30 (12.2)	8 (8.5)	22 (14.5)	
DOT, n (%)		93 (37.8)	52 (55.3)	41 (27.0)	*<0.0001*

Notes: PTB=pulmonary TB; EPTB=extrapulmonary TB; MTB=Mycobacterium tuberculosis, RIF= rifampicin; TB=tuberculosis.

RESULTS

Baseline characteristics of the study population

During the study period, 246 individuals, all from Senegal, were diagnosed with TB at HCD, with 94 cases (38.2%) detected before and 152 cases (61.8%) after the onset of the COVID-19 pandemic (Table 1). Out of them, 156 (63.4%) were male, with a mean age of 35.5 years (range: 25-50 years). The majority of diagnoses occurred in Diofior (n=38), Palmarin (n=33), Dangane (n=19), and Samba Dia (n=18) (Figure 1). Study population included students (n=20), housewives (n=12), farmers (n=7), merchants (n=6), fishermen (n=4), drivers (n=3), builders (n=3), healers (n=2), teachers (n=2), other (n=11); this information was not available for 176/246 patients; more details on the study population are described in Table 1. HIV testing was conducted for 228 patients (92.7%), yielding a positivity rate of 7.0% (n=16). Blood glucose levels were assessed in 214 patients (87.0%), with abnormalities found in 13 (6.1%).

Figure 1a - Map of Senegal.

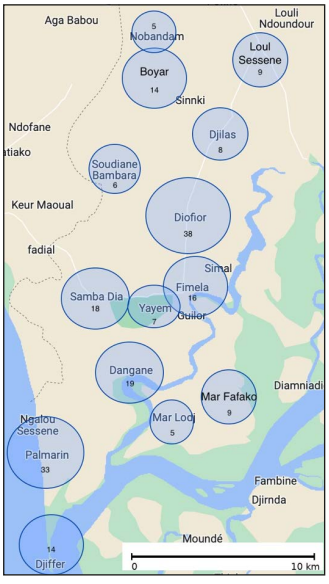

Figure 1b
Place of residency of TB cases and number of new cases notified in the study period.

During the study period, 246 individuals, all from Senegal, were diagnosed with TB at HCD, with 94 cases (38.2%) detected before and 152 cases (61.8%) after the onset of the COVID-19 pandemic (Table 1). Out of them, 156 (63.4%) were male, with a mean age of 35.5 years (range: 25-50 years). The majority of diagnoses occurred in Diofior (n=38), Palmarin (n=33), Dangane (n=19), and Samba Dia (n=18) (Figure 1). Study population included students (n=20), housewives (n=12), farmers (n=7), merchants (n=6), fishermen (n=4), drivers (n=3), builders (n=3), healers (n=2), teachers (n=2), other (n=11); this information was not available for 176/246 patients; more details on the study population are described in Table 1. HIV testing was conducted for 228 patients (92.7%), yielding a positivity rate of 7.0% (n=16). Blood glucose levels were assessed in 214 patients (87.0%), with abnormalities found in 13 (6.1%).

Pulmonary TB was diagnosed in 234 patients (95.1%), while 12 had extrapulmonary TB (9 lymphadenitis, 2 pleural TB, and 1 peritoneal TB). Out of those with pulmonary TB (234), sputum smear microscopy was positive in 199 individuals (85.0%); among those with negative sputum microscopic examination (26/234), 14 had positive Xpert MTB/RIF, 7 had CXR suggestive for TB, and 5 received a clinical diagnosis. Thirteen individuals reported a previous history of TB. Nearly all patients (n=243/246, 98.8%) initiated the standard anti-TB regimen composed of 2RHZE/4RH, with 198 (80.5%) completing their therapy. No rpoB resistance was detected during the study period when molecular testing was used. Directly observed treatment (DOT) was administered to 93 patients (corresponding to 37.8% of total treated patients), with a statistically significant difference between pre-COVID-19 and during-COVID-19 period (55.3% and 27.0%, respectively, p<0.0001).

Statistically significant differences were observed between the two study periods for several variables. The proportion of patients with positive sputum smear microscopy was higher during the COVID-19 period compared to the pre-COVID-19 period (30.0% vs. 15.1%; p=0.03). Similarly, the rate of Xpert MTB/RIF positivity increased significantly (100.0% vs. 77.8%; p=0.04). The percentage of patients with previous TB history decreased (2.7% vs. 9.9%; p=0.04), and the proportion of patients receiving DOT was markedly lower during the COVID-19 period (27.0% vs. 55.3%; p < 0.0001).

Annual TB case notification

While TB notification at HCD was rather stable in 2018 and 2019 with 44 and 45 cases notified, respectively, in 2020 TB notifications decreased by 24.4% when compared with 2019, with a subsequent increase of 70.6% in 2021 and 91.2% in 2022 compared to 2020 (Figure 2).

TB treatment outcomes

In total, treatment success was achieved in 198 patients (80.5%), while 10 (4.1%) died, 30 (12.2%)

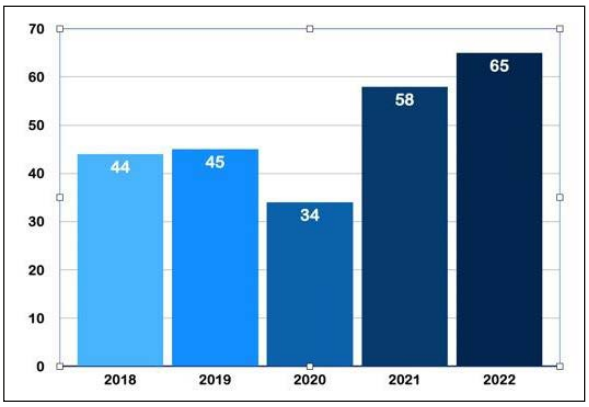

Figure 2a - New TB incident cases notified at HCD between 2018 and 2022.

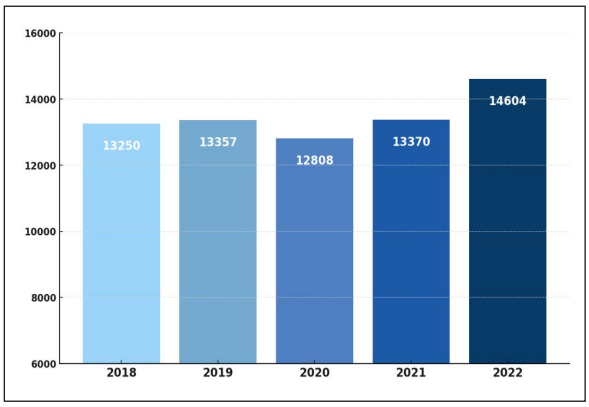

Figure 2b - New TB incident cases notified in Senegal between 2018 and 2022 [1].

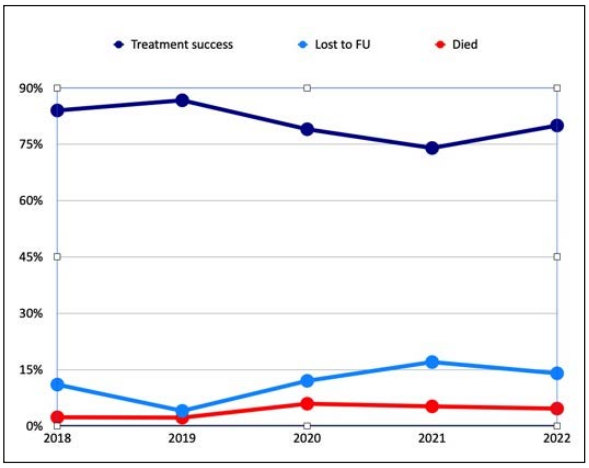

Figure 3 - TB treatment outcome from 2018 to 2022 at HCD.

were lost to follow-up, 4 (1.6%) were transferred out, and 4 (1.6%) experienced treatment failure (Table 1, Figure 3). When comparing the treatment outcomes between the pre-COVID-19 and the during-COVID-19 periods, treatment success rate dropped from 85.1% to 77.6% while lost to follow-up increased from 8.5% to 14.5% and death rate increased from 2.1% to 5.3% (p=0.38 with Chi-squared test). All deaths were due to TB.

DISCUSSION

In our study the 24.4% decline in new TB notifications observed in 2020 compared to 2019 is significantly higher than the 2.3% decrease reported in similar settings within the African Region, as noted in the WHO Global Tuberculosis Report 2022 [8, 9]. However, similar declines in new TB cases notifications have also been reported in other studies conducted across African countries [10-13]. The drop in TB notifications in 2020 compared to the pre-COVID-19 period is likely due to movement restrictions, reduced access to TB services and decreased focus on the TB disease, although it may reflect also a reduced TB transmission in the community due to limited mobility and public gatherings, use of masks and other factors [3, 14, 15].

Several indicators showed statistically significant differences between the pre- and during-COVID-19 periods. The proportion of patients with positive sputum smear microscopy was significantly higher during the pandemic (30.0% vs. 15.1%; p=0.03), which may reflect more advanced disease at the time of diagnosis due to delayed access to care. Additionally, all individuals tested with Xpert MTB/RIF during the COVID-19 period were Xpert MTB/RIF positive (100.0% vs. 77.8%; p=0.04), possibly reflecting prioritization of patients with more severe clinical profiles. A lower proportion of patients reported previous TB history (2.7% vs. 9.9%; p=0.04) in during-COVID-19 period, potentially indicating gaps in long-term follow-up.

In many settings, disruption of TB services due to shift of human resources from TB service to COVID-19 facilities and supplying interruptions of TB diagnostics and anti-TB drugs have been described [2]. This is supported by the subsequent increase in notified cases observed in 2021 and

2022, when the services returned to their full operationality. On the contrary, in Fimela district, the TB outpatient clinics and outreach programs conducted through the badieu'ngox continued to operate during the COVID-19 pandemic, there was no reallocation of human resources from TB service to COVID-19 units and no stocks out of TB diagnostics nor first-line drugs were recorded. This is likely justified by the relatively low number of COVID-19 cases in the district and limited impact of the pandemic on the health system routine activities. However, a drop in daily attendance at the health facilities was recorded. As described elsewhere, the restrictions, along with the stigma associated with both TB and COVID-19, compounded by the fear of infection, may have played a major role in determining a significant reduction in the number of patients seeking care, rather than a TB service interruption [16, 17]. After the drop of 2020, a sharp increase in 2021 and 2022 case notification has been noted, likely due to delayed diagnosis of accumulated cases in the earlier year, rather than due to a sudden increase of TB epidemiology after the rise of COVID-19.

The increase in TB mortality observed in the COVID-19 period does not appear to be attributable to coinfection with the SARS-CoV-2 virus, but rather to difficulties in accessing care due to movement restrictions and delayed diagnosis [18-21], although evidence from Italy suggests that direct SARS-CoV-2 infection can negatively impact TB treatment outcomes and follow-up [22]. Similarly, a higher rate of loss to follow-up has been recorded, likely due to the same challenges in accessing care and difficulties with transportation. These issues are largely associated with poverty and stigma [23, 24]. While the WHO Global TB Report highlighted a decline in TB mortality in 2020 and 2021 within the African Region, the findings from our study indicate an increase in TB mortality, consistent with other studies [8, 10, 11]. The reduced utilization of DOT in the during-COVID-19 period compared to the pre-COVID-19 period ($p<0.0001$), likely attributable to reduced community health workers' mobility due to curfew and movement restrictions, and barriers limiting the badieu'ngox access to patients' home including stigma and fear of SARS-CoV-2 infection, contribute explaining the worse treatment outcomes (in particular the higher loss to follow up and increased mortality) observed in the during-COVID-19 study period. On the other hand, while the co-infection with HIV definitely plays a role in determining worse TB treatment outcomes including higher mortality, the co-infection with HIV unlikely contributed to the higher mortality during COVID-19 period, as the co-infection rate in the two study periods is similar (5.4% versus 8.1%) and did not achieve statistically significant difference.

While COVID-19 disruption of active case finding and pre-existing TB care pathway from diagnosis to TB treatment also in other African countries like Tanzania have been reported [25], some promising data from South Africa and Ghana describing the added value of a bi-disease (COVID-19 and TB) testing approach have been described, suggesting the need to explore integrated approaches to multiple diseases, exploiting the use of combined molecular tests for an early diagnosis and favorable treatment outcomes [26, 27].

The main limitations of this study include its retrospective nature, the limited sample size of study population and the lack of data from other regions of Senegal to be compared with our results. In addition, the study lacks data on COVID-19 status among TB patients, and therefore conclusions about the direct versus indirect impact of COVID-19 on TB outcomes cannot be derived from this study.

The strength of this study is that it highlights real life data of TB notifications and treatment outcomes in a rural area of West Africa before and during the COVID-19 pandemic, aiming to fill (at least partially) the existing knowledge on the effect of COVID-19 on TB services in rural Africa.

The understanding of what happened during COVID-19 pandemic in rural resource-limited area like Senegal might be relevant to avoid similar scenarios in case of future health crises. In particular, anticipating and addressing community health workers and patients' mobility barriers to ensure prompt diagnosis as well as treatment continuity and monitoring should be warranted.

CONCLUSIONS

Despite the relatively few cases of COVID-19 reported in Senegal and the limited impact of COVID-19 pandemic on TB services described in African countries compared to other settings at the global level, this study demonstrates that the pan-

demic significantly impacted on TB notification and TB treatment outcomes in this rural area of Senegal, more likely due to difficult access to care rather than TB service disruption per se.

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Conflicts of interest
The authors declare no conflict of interest related to this study.

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