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Research Article

Delivering HIV and TB services amidst the COVID-19 pandemic in Indonesia: a qualitative study of challenges and mitigation strategies

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Background

Indonesia has the second-highest burden of tuberculosis (TB) globally and is experiencing one of the fastest-growing HIV epidemics worldwide. The COVID-19 pandemic disrupted access to essential health services, including those for TB and HIV, due to health system overload, social distancing measures, and negative economic repercussions on the health sector and the population. An in-depth understanding of these challenges and the health system responses to mitigate the negative impact of the pandemic on TB and HIV services is crucial to building health system resilience and preparing for future emergencies.

Methods

This qualitative study, conducted in two cities in Indonesia, explored the impact of the COVID-19 pandemic on TB and HIV services including mitigation strategies to sustain the provision of testing and treatment in the midst of the pandemic. Between February and June 2022, semi-structured interviews were conducted with 16 healthcare workers and 16 clients at nine health centers (puskesmas), three hospitals, and one Community Center for Lung Health in Bandung and Yogyakarta. Themes were identified from transcripts using open and selective coding and then refined.

Results

Extraordinary measures were implemented in health facilities to sustain TB and HIV service delivery, and prevent the spread of COVID-19, including testing of clients for COVID-19 before receiving medical care, physical distancing when visiting healthcare facilities, revised schedules for medicine dispensing, involvement of community health workers and peers in community outreach activities such as the home delivery of medicines, and the use of telemedicine. Challenges encountered during the implementation of these strategies included medicine stock-outs, health worker overload, lack of sufficient client-provider interaction and technical difficulties when implementing telemedicine, and the risk or fear of exposure to COVID-19 among the community health workers and peers.

Conclusions

Significant efforts were made to mitigate disruptions to TB and HIV services during the COVID-19 pandemic. However, some challenges were encountered. Key policy recommendations to strengthen pandemic preparedness include investing in local manufacturing and robust drug supply networks to prevent medicine shortages, and

supporting community health workers to alleviate workload issues, reduce the risk of disease exposure, and explore the potential for a financial incentive system. Equally vital is the need to invest in staff training and education, as well as implementing user-friendly telemedicine technologies.

Over 6.9 million deaths among approximately 772 million confirmed COVID-19 cases globally were reported to the World Health Organization (WHO) as of 6th December 2023.[1] Tuberculosis (TB) and HIV care were greatly disrupted during the COVID-19 pandemic, with reduced access to diagnostic services and delays in treatment initiation. The Global Tuberculosis Report by the WHO, published in 2022, documents an almost 20% decline in the number of people newly diagnosed with TB, from more than 7 million in 2019 to 5.8 million in 2020.[2] The UNAIDS Global AIDS Update in 2022 reported similar challenges in HIV services, with a smaller increase in the number of people getting HIV treatment in 2021 compared to 2020, i.e. the number of people receiving HIV treatment in 2020 increased by 2 million versus by 1.47 million in 2021.[3]

Indonesia is among the countries in Asia most heavily affected by the COVID-19 pandemic. As of 7th April 2024, more than 6.8 million confirmed cases and more than 162,000 COVID-19-related deaths were reported to the WHO.[1] While Indonesia experienced a steady decline in TB incidence from 370 to 301 per 100,000 population between 2000 and 2020, in 2022 there was a sharp increase in the incidence rate to 385 per 100,000 population.[4,5] Furthermore, in 2020, Indonesia was among the top ten countries globally with the highest burden of TB, HIV-associated TB, and multi-drug or rifampicin-resistant (MDR/RR)-TB.[2] It was also among the top 10 countries that contributed to a global decrease of more than 90% in TB case notifications among people newly diagnosed with TB since 2020, compared with 2019.[2] Further impact of the COVID-19 pandemic on TB services in Indonesia has been documented by our team[6] and others.[7-9] We have previously shown that the rates of tuberculosis testing, treatment completion rates, and successful treatment rates decreased in two Indonesian cities (Yogyakarta and Bandung) during the COVID-19 pandemic.[6] A modelling study estimated the impact of the disruptions on TB-related outcomes in Indonesia: one of the key predictions being that the worst-case scenario for cumulative TB-related mortality during the five-year period from 2020 to 2024 is 10% to 12% higher than it was prior to the pandemic.[9]

The HIV epidemic is also a concern in Indonesia. In 2023, around 0.3% of the population aged 15-49 was infected by the virus,[10,11] with considerable variation across provinces.[12] Estimates from UNAIDS in 2023 revealed an alarmingly high HIV prevalence among key population groups at higher risk of HIV infection: 13.7% of people who inject drugs; 17.9% of men who have sex with men; 11.9% of transgender individuals; and 2.1% of sex workers.[11] Our study[6] and several other studies[13-16] have documented the impact of the COVID-19 pandemic on HIV programs and services in Indonesia. In our study, we noted that compared to the pre-pandemic period, individuals living with HIV who visited hospitals had a lower likelihood of starting anti-retroviral treatment (ART), staying in care, and adhering to ART during the pandemic.[17]

These disruptions were due, among other things, to social distancing orders, lockdown, and healthcare workers being redeployed to work on COVID-19 testing, contact tracing, and surveillance activities. As documented in previous studies, known barriers to accessing HIV services included fear of contagion of COVID-19 at health facilities, financial difficulties, distance to the clinics which increased the expense of transportation, and stigma associated with both HIV and COVID-19.[16,18]

In May 2023, the WHO declared COVID-19 was no longer a public health emergency of international concern,[19] and updated its Strategic Preparedness and Response Plan 2023-2025 to support the development of more resilient health services worldwide and prepare for future public health crises.[20] In this report, the WHO recommends countries share their pandemic mitigation strategies in detail, providing experiences and evidence about what works best and associated challenges.[21] In September 2023, the United Nations (UN) General Assembly high-level meeting further highlighted the political commitment to strengthen international collaborations for pandemic preparedness and response, incorporating the lessons learned from the COVID-19 pandemic and other health crises.[22] Based on qualitative interviews with health workers and TB and HIV clients in Indonesia, the study presented here aims to document these lessons for Indonesia, contributing to the pool of studies conducted elsewhere exploring mitigation strategies to maintain TB and HIV services during the pandemic.[23-28]

METHODS

STUDY SETTING

This study was conducted as part of the larger DOMINO study funded by the United Kingdom National Institute for Health Research (UK NIHR) and UK Research Innovation (UKRI) through their Global Effort on COVID-19 (GECO) Health Research funding scheme, with the aim of exploring the collateral impact of the COVID-19 pandemic on TB and HIV services in Indonesia. In the DOMINO study, we conducted an observational cohort across TB and HIV facilities in two major cities, Bandung and Yogyakarta, to assess the cascade of testing and treatment for TB and HIV before and during the pandemic, in order to identify the impact of the COVID-19 outbreak on TB and HIV services before and after the outbreak. We utilized routinely collected clinic data to measure various metrics along the TB and HIV cascades of care, such as testing, linkage to care, retention in care, and treatment outcomes.[6,17] Additionally, we employed qualitative methods to explore the perspectives and experiences of both patients and healthcare providers regarding TB and HIV services during the pandemic. This in-

cluded examining changes in treatment seeking behavior and identifying actions taken to mitigate service disruptions. The current paper is part of the qualitative component of the study designed to explore mitigation strategies implemented in these two cities to sustain the delivery of TB and HIV testing and treatment amidst the pandemic, as well as the challenges encountered in implementing these strategies.

The DOMINO study was conducted in two cities in Java Island, where the vast majority of the Indonesian population resides. Bandung City (West Java Province) and Yogyakarta City (Special Region of Yogyakarta) were chosen since these were among the cities with the highest burden of HIV, TB, and COVID-19 in Indonesia. In Yogyakarta, the TB case notification rate in 2020 and 2021 decreased compared to 2019, dropping from 145.18 per 100,000 population in 2019 to 103.45 per 100,000 population in 2020 and 115.73 per 100,000 population in 2021.[29] Similarly, there was a decrease in the number of new HIV/AIDS cases detected in Yogyakarta in 2020 and 2021 compared with 2019.[29] In 2019, 101 new HIV/AIDS cases were reported, whereas in 2020, there were 65 new cases, and in 2021, there were 67.[29] As of 2021, the cumulative number of reported HIV cases in the city reached 1,421.[29] In Bandung, the TB case notification rate in 2020 was 339 per 100,00 population, a decrease from 477 per 100,000 population in 2019.[30] The number of new HIV/AIDS cases reported in Bandung decreased significantly, dropping from 470 cases in 2019 to 149 cases in 2020.[30] As of December 2021, the Bandung AIDS Committee reported a total of 5843 HIV cases in Bandung.[31]

In June- August 2021, there was a sharp increase of COVID-19 cases in Indonesia due to the Delta variant of SARS-CoV-2.[32] To address this, the government implemented various public health strategies, including the Community Activities Restrictions Enforcement (CARE) in areas with high COVID-19 cases, including in Yogyakarta and Bandung where the study was conducted. The CARE policy involved a range of measures to control the spread of COVID-19 through restrictions to population mobility, including the suspension of in-person teaching and learning at schools, the halt of office work with a shift to working from home, restrictions on religious activities where all places of worship were closed to the public, and the closure of public facilities along with restrictions on public gatherings.

In both cities, and across the whole country, health services are delivered through public and private health facilities. City or District health offices (DHOs) supervise both the public sector and the private sector in their administrative areas.[33] In the public sector, health centers (Puskesmas) serve as a pillar for the TB program and are required to keep track of TB cases, treat newly diagnosed and recurrent pulmonary infections, conduct surveillance activities, and engage in health promotion initiatives.[34] Puskesmas, like other health facilities, are required to document and report their TB activities to the national TB working group of the Ministry of Health,[34] although private care providers have not played a substantial role in TB management.[34] Puskesmas are also involved in the HIV programme, which has expanded significantly since 2015.[35] In 2022, there were at least 11,299 health facilities with HIV testing available in their clinics - 3,654 HIV care support and treatment facilities and 598 health facilities with a prevention of mother-to-child transmission HIV program in the country.[36]

The city of Yogyakarta spans an area of 32.5 km^2 and comprises 14 subdistricts. In 2020, the city's population stood at 414,704. Approximately 7.1% of its population did not complete primary school. In Bandung, there are 30 subdistricts with an estimated total population of 2,510,103 people. The City Profile Report indicates that, on average, people in Bandung City receive education for approximately 10.75 years, equivalent to the 10^{th} grade in high school.[29,30] As of November 2022, the Yogyakarta City Government reported 35,763 confirmed COVID-19 cases.[37] As of June 2023, the Bandung Government reported 106,156 confirmed COVID-19 cases.[38]

DATA COLLECTION

Interviews were conducted with healthcare workers (nurses, doctors, community health workers) and TB and HIV clients purposively selected from nine puskesmas, three hospitals, and one Community Center for Lung Health in Bandung and Yogyakarta between February and June 2022. The healthcare worker participants were those in charge of the TB and/or HIV program in these facilities, while clients were selected with assistance from healthcare workers. For TB clients, we selected clients who had been in treatment for at least two months. For HIV clients, we selected those who had been on treatment and care before and during the COVID-19 pandemic.

Semi-structured interview guides were developed based on a similar study on mitigation strategies conducted in Kenya[26] and other studies of health system challenges during the COVID-19 pandemic associated with this study.[39, 40] The interview guides for the healthcare workers and the clients consisted of questions about the impact of the COVID-19 pandemic on TB and HIV programs, mitigation strategies taken to reduce the impact and challenges in implementing these strategies, the daily routines of health workers, perceived quality of care and medical supplies and COVID-19 exposure.

Interview guides were piloted in nearby study locations sharing comparable geographical and health service characteristics with the study sites to refine the questions and probes. All interviews took place at the health facilities and lasted between 30 and 90 minutes. If permission was given, interviews were recorded. Local researchers with training and experience in social research methods conducted the interviews in Bahasa Indonesia. Participants provided written informed consent for their data to be utilized in this research project.

DATA ANALYSIS

The framework for health system resilience developed by the World Bank[41] was used to guide the analysis. This

framework advises various actions to consider for Pandemic Preparedness and Response (PPR) improvement. In this framework, the core capacities to improve resilient health systems include health intelligence, health service delivery, community engagement and risk communication, and the health supply chain. Specifically, this framework mentions the need to evaluate healthcare facilities to determine their readiness for unforeseen events, leverage the use of community health workers (CHWs); ensure the protection of frontline staff, develop strategies for utilizing alternative healthcare delivery platforms including telemedicine, enhance forecasting capabilities, emergency logistics, supply chain management plans and contingency procurement plans, and tackle shortages in human resources.

Audio recordings of the interviews were transcribed verbatim. Thematic analysis of the transcripts was conducted to identify themes and emerging issues, using selective coding based on the categories in the framework and open coding to capture emerging themes. Data analysis was conducted by Indonesian researchers trained in qualitative research with extensive experience in HIV/TB research in Indonesia. The analysis was, firstly, conducted by two local researchers (SNSN & SDW) on NVivo software, version 13 (Lumivero, Denver, USA). To improve the accuracy of the interpretation, member checking was then conducted,[42] whereby a senior researcher (LPLW) compared the coding and themes developed by SNSD and SDW. Discrepancies were resolved through discussion with another senior qualitative researcher (ML). A consensus meeting was then held among SNSN, SDW, LPLW, YM, AP, and ML to review the categories and themes. Finally, a stakeholder meeting was conducted to check the accuracy of the data, verify our interpretation, and obtain further input regarding emerging findings.[42] The Standards for Reporting Qualitative Research[43] were used to guide the development of the manuscript.

This study was approved by the ethics committees at the University of New South Wales (HC200989), London School of Hygiene and Tropical Medicine (22829), and Universitas Gadjah Mada (KE/FK/1410/EC/2021).

RESULTS

PARTICIPANTS' CHARACTERISTICS

Thirty-two participants were interviewed, including 16 health workers and 16 clients. Most health workers were women (14/16, 87.5%) and worked in primary healthcare (12/16, 75%), with a mean number of working years of 21.6 (Standard Deviation (SD) 7.9). Their educational backgrounds varied, from high school to master's degree. (Table 1)

The mean age of clients included in the study was 35 years (SD 8.8). More than 50% of clients were female, attained high school level education, and were employed in the private sector. (Table 2)

The themes that emerged from the interviews regarding efforts to maintain TB and HIV service delivery and the challenges encountered are described below; the themes are organised around the broad categories in the health system resilience framework.[41] Quotes are used to exemplify each theme.

MITIGATION STRATEGIES IMPLEMENTED IN HEALTH FACILITIES

HEALTH SERVICE DELIVERY

In order to stay open and deliver TB and HIV health services, various preventive measures were developed and implemented, described in the sections below.

MODIFICATION OF STANDARD OPERATING PROCEDURES (SOPS) TO REDUCE COVID-19 TRANSMISSION INSIDE HEALTH FACILITIES.

Healthcare workers mentioned that SOPs had been amended in their workplace in keeping with the government's regulations.

> "For the prevention of COVID-19 [transmission], we follow the SOP. PPE [Personal Protective Equipment] must be always worn, [we need to] wash [our] hands. Then there are SOPs related to contact with the client; after touching the client we must wash our hands, at least use a hand scrub.... our staff disinfect everything, including the waiting chairs. It's being done every day." – **HIV Healthcare Worker, Puskesmas G, Bandung**
> "At the beginning of the pandemic, we used N95 masks only with MDR-TB clients, but now N95 masks are easily available, so we use them with all TB clients (...) Before the pandemic, I didn't wear a gown; now I wear it, based on the SOP. If we are in the TB clinic, we know that we need to use gowns, N95 or KN-95 masks ....." – **TB Healthcare Worker, Puskesmas G, Bandung**

It was also reported that clients were tested for COVID-19 before receiving medical care.

> "Before the pandemic, we just walked into the health facility. Now, we must do a COVID-19 swab. Even if there are symptoms of cough related to TB, we need to test for COVID-19 first and see the results." – **TB Client, Puskesmas T, Yogyakarta**
> "As a first step, clients go to the influenza-like illness polyclinic, in the blue tent. They take a COVID-19 swab test, then PCR; only then they can enter the Puskesmas." – **TB Healthcare Worker, Puskesmas G, Bandung**

Furthermore, clients were required to maintain physical distancing when visiting healthcare facilities.

> "It is mandatory for all clients to sit orderly. If many clients are standing, the room is full, and the security guard will ask all standing clients to leave. No crowds. The goal is not to have crowds." – **TB Healthcare Worker, Puskesmas T, Yogyakarta**
> "The benches are marked here to keep social distancing." – **TB Client, Puskesmas G, Bandung**

THE USE OF TELEMEDICINE

Telemedicine and online consultations were used by many health workers and clients as a key strategy for maintaining

Table 1. Characteristics of TB and HIV healthcare workers included in the study

Participants' characteristics	TB healthcare workers n (%)	HIV healthcare workers n (%)	Total n (%)
Total number of participants	8	8	16
Age (years)			
Mean (SD*)	47.25 (SD=5.3)	43.13 (SD=7.6)	45.2 (SD=6.7)
Age (groups)			
21-30	0 (0)	0 (0)	0 (0)
31-40	1 (12.5)	3 (37.5)	4 (25)
41-50	3 (37.5)	3 (37.5)	6 (37.5)
>50	4 (50)	2 (25)	6 (37.5)
Gender			
Female	8 (100)	6 (75)	14 (87.5)
Male	0 (0)	2 (25)	2 (12.5)
Education Level			
High school	0 (0)	1 (12.5)	1 (6.25)
College (Diploma)	4 (50)	3 (37.5)	7 (43.75)
University (Bachelor's degree)	3 (37.5)	4 (50)	7 (43.75)
University (Master's degree)	1 (12.5)	0 (0)	1 (6.25)
Location			
Puskesmas	6 (75)	6 (75)	12 (75)
Hospital	1 (12.5)	2 (25)	3 (18.8)
Community Center for Lung Health	1 (12.5)	0 (0)	1 (6.2)
Working experience at the clinic (years)			
Mean (SD)	10.8 (SD=5.4)	11.7 (SD= 9.0)	11.3 (SD=7.2)
Overall experience (years)			
Mean (SD)	23 (SD=7.1)	20.1 (SD=8.7)	21.6 (SD=7.9)

*SD – standard deviation

the provision of primary care services as well as TB and HIV treatment:

> "If clients have any complaints, they can consult me by phone. At the beginning of treatment, I give them my phone number and ask them to call me if they have any concerns" – **TB Healthcare Worker, Puskesmas T, Yogyakarta**
> "The online consultation for TB services is very fast. When I got TB, the nurse immediately contacted me. The doctor said: "this is TB; I will give you the nurse's number. Later you can WhatsApp (WA) him." – **TB Client, Puskesmas T, Yogyakarta**
> "Online consultation is available. There is JKN mobile; there is a WhatsApp group for online inquiries. Usually, clients directly WhatsApp the doctor; they prefer this app. During the pandemic, online consultations have indeed increased." – **HIV Healthcare Worker, Puskesmas U1, Yogyakarta**

SUPPLY OF MEDICINES

REVISED SCHEDULES FOR MEDICINE DISPENSING

Before the pandemic, HIV clients would refill ART in their clinic every month. During the pandemic, however, a multi-month dispensing routine was implemented to reduce client-staff contact.

> "This year, we get the medicine for two months. So, we don't need to go to the hospital every month. It's much better." – **HIV Client, Puskesmas P, Yogyakarta**
> "According to the MMD [Multi-Month-Dosing] policy, each client can receive medicine for two months." – **HIV Healthcare Worker, Hospital S, Yogyakarta**
> Similarly, in TB clinics, the interval for collecting medicines was extended for TB clients both in the intensive phase (which lasts from the beginning of anti-TB treatment until two months, during which time TB patients must take medication daily) and the continuation phase (which lasts from the second month to six months or more, during which time patients are only required to take anti-TB medicine three times a week).

Table 2. Characteristics of TB and HIV clients included in the study

Participants' characteristics	TB clients n (%)	HIV clients n (%)	Total n (%)
Total number of participants	8 (100)	8 (100)	16 (100)
Age (years)			
Mean (SD*)	35.5 (SD=12)	34.5 (SD=4.4)	35 (SD=8.8)
Age (groups)			
21-30	4 (50)	2 (25)	6 (37.5)
31-40	1 (12.5)	5 (62.5)	6 (37.5)
41-50	2 (25)	1 (12.5)	3 (18.75)
>50	1 (12.5)	0 (0)	1 (6.25)
Gender			
Female	7 (87.5)	2 (25)	9 (56.25)
Male	1 (12.5)	6 (75)	7 (43.75)
Education Level			
High school	6 (75)	4 (50)	10 (62.5)
College (Diploma)	0 (0)	1 (12.5)	1 (6.25)
University (Bachelor's degree)	2 (25)	3 (37.5)	5 (31.25)
University (Master's degree)	0 (0)	0 (0)	0 (0)
Location			
Puskesmas	6 (75)	5 (62.5)	11 (68.75)
Hospital	1 (12.5)	3 (37.5)	4 (25.0)
Community Center for Lung Health	1 (12.5)	0 (0)	1 (6.25)
Occupation			
Student	1 (12.5)	0 (0)	1 (6.25)
Government employed	0 (0)	0 (0)	0 (0)
Private sector employed	3 (37.5)	6 (75)	9 (56.25)
Entrepreneur	2 (25)	1 (12.5)	3 (18.75)
Unemployed	2 (25)	1 (12.5)	3 (18.75)

*SD – standard deviation

> "Usually, the schedule to get the [refill] is once a week, then it was changed to once a month to reduce the risk of clients being infected with other pathogens" – **TB Healthcare Worker, Puskesmas S, Bandung**
> "There is a special day for TB client services at this Puskesmas, every Thursday. Before the pandemic, it was once a week for the [clients in] intensive [treatment] phase. However, during the COVID-19 pandemic, it is once every two weeks. For the [clients in] continuation [treatment] phase, it was once every 2 weeks before the pandemic. But during the COVID-19 pandemic, medicine is refilled once a month." – **TB Healthcare Worker, Puskesmas J, Yogyakarta**

COMMUNITY ENGAGEMENT

INVOLVEMENT OF PEERS IN THE HOME DELIVERY OF HIV MEDICINE

Peer groups (of people living with HIV) were mobilized in the study setting even before the pandemic. As was mentioned by many clients and healthcare workers, the benefit of involving peers in home delivery of HIV medicines was particularly valued during the pandemic to ensure the continuation of service delivery, as many clients were reluctant to visit the health facilities.

> "During the COVID-19 pandemic, many clients didn't want to come to the puskesmas because they were afraid. Peer support groups have helped a lot. We collect medicine at the health facilities, deliver it to their homes, or meet them somewhere. If the client lives outside the city, the medicine will be sent there." – **HIV Client and Peer Support Member, Yogyakarta**
> "There are usually peers who take care of it. The healthcare workers do not deliver the medicines. They ask for help from peers or their family to get medicine at this health facility. What's important is that we know how many medicines they have at home, how much they weigh, and whether they have any complaints. It is not just taking medicine, but we, doctors, also need to know the client's condition." – **HIV Healthcare Worker, Puskesmas U1, Yogyakarta**

ENGAGEMENT OF COMMUNITY HEALTH WORKERS

Although community health workers, referred to as TB cadres, have been involved in TB service delivery for many

years, the COVID-19 pandemic further highlighted their value in supporting the TB program. During the pandemic, community health workers provided COVID-19-related services, such as contact tracing, in addition to TB services, alleviating pressure on formal health workers. The involvement of community health workers in the home delivery of TB medicines or screening was seen as crucial to helping to mitigate staffing shortages during the pandemic.

> "If there are obstacles among clients, they finally ask for help from TB cadres. "Ma'am, can you help me get the medicine?" Sometimes this happened, so I asked 1-2 cadres for help." – **TB Healthcare Worker, Puskesmas G, Bandung**
> "In all four sub-districts, puskesmas actively report [TB cases]. So as soon as there are new or suspected TB clients, I immediately send cadres from each sub-district to go directly to the field. And I tell them to contact me immediately if they find a new case"– **TB Healthcare Worker, Puskesmas B, Bandung**
> "We ask for help from TB cadres in the region. When TB cases decrease, we also involve them in tracing [of the COVID-19 cases]. Because if we do it ourselves, we are also constrained by time and energy." – **TB Healthcare Worker, Puskesmas U1, Yogyakarta**

CHALLENGES ENCOUNTERED DURING THE IMPLEMENTATION OF MITIGATION STRATEGIES

Despite these efforts to alleviate the impact of the COVID-19 outbreak on TB and HIV services, various challenges were experienced during the pandemic, as described in the sections below.

HEALTH SERVICE DELIVERY

LONGER WAITING TIMES FOR CLIENTS NEEDING TO ACCESS SERVICES

Concerns regarding potential delays in clinical settings as a result of modifications to SOPs were raised by some clients; particularly the need to test for COVID-19 before receiving TB or HIV services. Some clients complained that this extraordinary measure, along with the time needed to receive the test results, led to longer waiting times. For this reason, some TB clients were reluctant to visit clinics to access TB treatment.

TECHNICAL PROBLEMS ENCOUNTERED AND LACK OF IN-PERSON INTERACTIONS WHEN IMPLEMENTING TELEMEDICINE

Healthcare workers in four puskesmas and one client from Bandung hospital reported major challenges with using the app for telemedicine, due to a lack of in-person interaction, technical problems in using the app, and lack of staff to respond to technical queries submitted by clients via the app.

> "We cannot say that the service is complete after online consultation. It can help our communication with clients, but it really cannot be as complete as when we meet. So maybe some things are missing because of online consultation." – **HIV Healthcare Worker, Puskesmas T, Yogyakarta**
> "One function of the app is to remind you to take medicine. And clients can also have a consultation [through the app]. However, it doesn't seem to work anymore. I don't know what the problem is, maybe it's the budget or something else." – **HIV Healthcare Worker, Puskesmas I, Bandung**
> "We've changed our [phone] number. Meanwhile, logging in to the application requires us to input our phone number registered with S Hospital the first time we registered there. Now it (the number) is gone, we have a new number. That's one of the problems too" – **HIV Client, Puskesmas U1, Yogyakarta**
> "Apart from that, we need more staff here. Who wants to handle it? Who is the operator? It has to be set right; you have to ask that. Even if you want to depend on me, I can't because my hands are full. But if there is a human resource [who could handle it], that's great." – **HIV Healthcare Worker, Puskesmas I, Bandung**

SUPPLY OF MEDICINES

STOCK-OUTS OF MEDICINES

Many healthcare workers from puskesmas and hospitals noted that stock-outs of medicines were common during the pandemic, requiring new strategies to address this issue. Common strategies included distributing one medicine package to several clients, switching to other medicines with similar properties, and borrowing medicines from other clinics.

> "In the early days of the pandemic, India and China were all locked down. Drug distribution was hampered. Medicine stock was limited, so it needed to be rationed. For example, one bottle of TLE [stands for Tenofovir, Lamivudine, and Efavirenz, which are antiretroviral medicines frequently taken together as a fixed-dose combination to treat HIV] contains 30 tablets. So, they distributed this amount to three clients, each receiving ten tablets. Then they waited for the supply again" – **HIV Client, Puskesmas U1, Yogyakarta**
> "Each report must have a buffer stock of drugs for three months. From there, we usually see how many clients there are; then we divide them up. For example, drug A, most drug A is TLE. The TLE is out of stock; it has not yet been delivered [by the DHO]. So, we share what we have. One bottle is for two people, half and half. So, the medicine is given for 15 days, 15 days." – **HIV Healthcare Worker, Hospital B, Bandung**

Healthcare workers from two puskesmas explained they needed to borrow medicines from other puskesmas, or even from other clients, due to shortages.

> "The stock of drugs for category 1 TB runs out at certain times. That's why we borrow it temporarily from the other puskesmas that had it. Then we'll replace it when it's in stock again. Because we get the medicine once a month. It happens that the stock from the DHO runs out." – **TB Healthcare Worker, Puskesmas T, Yogyakarta**
> "Sometimes we borrow from other puskesmas. Or sometimes, if it's not available at the health office, we can borrow it from other clients as well."- **TB Healthcare Worker, Puskesmas T, Yogyakarta**

COMMUNITY ENGAGEMENT

WORKLOAD

A healthcare worker at the Puskesmas in Bandung expressed concern about the growing workload of community health workers.

> "If we want to visit people's homes for contact tracing, it's not possible yet. The cadre is also limited. Some of them are also involved in the COVID-19 Task Force. So their burden is even higher." – **TB Healthcare Worker, Puskesmas G, Bandung**

THE RISK OF COVID-19 EXPOSURE

Additionally, a patient from Bandung mentioned the risk of COVID-19 exposure among these community healthcare workers.

> "You know, at S Hospital during the pandemic, there was actually a silver lining. If you couldn't make it to pick up your medication, it wasn't a big deal. They had peer support to help out.... the peer support volunteers ended up getting Covid... That's why many of them tested positive during that time." – **HIV Client, Puskesmas U1, Yogyakarta**

DISCUSSION

Various strategies were implemented in Indonesia to maintain the delivery of TB and HIV services during the pandemic. These included the amendment of SOPs with new prevention and control measures such as reducing frequent or close client-provider contacts in the health facilities, reducing client visits to clinics, the requirement of testing for COVID-19 before receiving medical care, physical distancing inside healthcare facilities, multi-month dispensing of medicines, involvement of community health workers and peers for community outreach activities including home delivery of medicines, and the use of telemedicine. Some challenges were encountered during the implementation of those strategies, including medicine stock-outs, health workers being overloaded, reduced client-provider interactions, lack of staff to handle telemedicine, technical difficulties when implementing telemedicine, and the high risk of COVID-19 exposure among community healthcare workers.

Multi-month dispensing of medicine was a common strategy to prevent people from having to frequently visit health facilities, thus reducing COVID-19 exposure. However, this strategy requires a large stocks of medicines available in the health facilities.[44] Unfortunately, healthcare workers mentioned that stock-outs often occurred, and that they needed to "borrow" medicines from other puskesmas. They also employed other strategies to ensure that their clients could still obtain medicines during stock-outs, such dividing the dosage of some medications. Similar challenges were reported in many other countries.[45,46] While medical product stock-outs are common in routine health service delivery, during the pandemic they were exacerbated by the global interruption of supply-chains.[47] All governments should therefore have adequate preparedness plans in place to guarantee continued access to TB and HIV medicines during pandemics and other emergencies. This may include increasing local manufacturing capacities and strengthening supply networks.

Our study also identified some important human resource challenges, including health worker overload, lack of training in telemedicine, and the high risk of COVID-19 exposure among community healthcare workers. While the availability of human resources for health has improved in Indonesia,[48] critical gaps remain, especially in more remote locations.[49,50] During the pandemic, this issue was complicated by the additional burden of dealing with COVID-19 testing, contact tracing, reporting, and surveillance.[51] Many healthcare workers were infected or died due to COVID-19.[52,53] In addition to these concerns, another study conducted in Indonesia found a strong correlation between the low number of healthcare workers during the pandemic, particularly doctors, and a reduction in TB treatment coverage compared with that before the pandemic.[8] This underscores the importance of having an adequate healthcare workforce in order to guarantee the provision of necessary medical care even during public health emergencies.

The widespread use of PPEs among health workers is essential to protect them and the patients from COVID-19 and sustain service delivery. The WHO recommends that managers monitor the appropriate use of PPEs in their health facilities and that each healthcare worker complies with hand hygiene.[54] Previous studies in Indonesia documented, however, significant shortages in PPEs during the early stages of the pandemic,[40,51] as in most other countries. In light of this, strategies to ensure the availability of PPE during the pandemic and future emergencies have been developed by organizations such as the Asian Development Bank, including monitoring usage and distribution and improving the capacity of domestic production.[55] Another key finding from our study is that peers and community health workers were used regularly to maintain the delivery of HIV and TB services during the acute stages of the pandemic, including home treatment. This is in line with guidance on pandemic prevention, preparedness and response by the UN General Assembly, which recognises the important roles of these community members[22] and the need to ensure their protection from harm during health crises. In general, the contribution of peers and community health workers in Indonesia is well recognised - they help people navigate the intricacies of bureaucracy while accessing healthcare services, particularly HIV testing and treatment, contribute to health promotion and education in the communities, and improve access to care.[56-58] These roles have become even more pronounced during the pandemic, further highlighting their value to empower the communities and bolster the healthcare system.

In addition to community-based services, we found that telephone consultations and WhatsApp chats were used regularly to maintain the delivery of HIV and TB services. This approach is in line with WHO's interim guidance on health workforce policy and management during the pan-

demic,[59] which emphasised the importance of digital technology in supporting response and mitigation efforts.[22] In this respect, we should also note that various mHealth solutions have been piloted recently in Indonesia, even before the pandemic.[60] For example, RUMA SELA is a customized mobile app based on the principle of self-learning for improving HIV prevention and treatment among men who have sex with men, transgender women, and people who use drugs in Indonesia. In 2020, an evaluation found that RUMA SELA contributed to improved HIV knowledge, increased testing and access to HIV health services, and safer sexual behavior.[60] Currently, the Indonesian government is considering scaling up a comprehensive digital health platform, known as SATU SEHAT ("One Health"), which can be used by patients and healthcare providers to schedule appointments and store all individual medical records. In the process, features of RUMA SELA could be integrated into this platform, providing specific advice to people living with HIV and target population groups for routine care and in the event of emergency.[61]

While telemedicine offers many benefits for both healthcare providers and patients,[62] implementation challenges in terms of app design and infrastructure are well documented, requiring user-friendly interfaces, adequate training and broad internet access.[63-65] Findings from another study indicate that high staff turnover within HIV programs is another important challenge, leading to inconsistencies in service delivery, and potentially affecting patient satisfaction and trust in telemedicine as a viable healthcare option.[66] Constant staff turnover also means that healthcare organizations have to invest more in training new staff on how to use telemedicine platforms and technologies, incurring additional costs and time, which can slow down the implementation process and response efforts in the event of an emergency.[67]

CONCLUSION

In conclusion, while health facilities have implemented several mitigation efforts to sustain service delivery during the pandemic, they have faced various implementation challenges. Stock-outs of PPE, medicines, and workforce challenges seems to be a considerable issue in maintaining TB and HIV services in these circumstances. Future pandemic responses should, therefore, include appropriate planning of equipment, supplies, and health personnel to ensure continued essential health service delivery and uptake. More investments to increase local manufacturing and robust drug supply networks to prevent medicine shortages, more investment in community health workers to address the issues of workload and risk of disease exposure in the workplace, and a possible financial reward system are worth considering. Investing in staff training and education, as well as implementing user-friendly telemedicine technologies, is equally crucial.

STRENGTH AND LIMITATIONS

This study examines the mitigation strategies to maintain HIV and TB services in Indonesia, including implementation challenges. Our findings, however, need to be reviewed with caution. Findings from selected interviews in Bandung and Yogyakarta may not be generalisable to all healthcare workers and HIV or TB clients across the country. In addition, a more comprehensive evaluation should also involve policymakers and other key stakeholders, in addition to healthcare workers and clients, to understand their perspectives and views about challenges to maintaining HIV and TB services during the COVID-19 pandemic and policy prospects for future emergencies. Secondly, after the declaration from the WHO regarding the COVID-19 status, which is no longer considered a public health emergency of international concern, other recommendations by the WHO to accelerate the recovery of health systems after the end of the pandemic[20] were not explored in this study, including the importance of strengthening the surveillance system and recommendations on the use of self-testing to reduce the burden on the health system. Retrospective studies of the impact of COVID-19 and future emergencies will benefit from quantitative surveys of health facilities across the country, using a standardised tool, such as the WHO's facility assessment tool, to assess the continuity of essential health services and better understand the challenges in sustaining the delivery of HIV and TB services during crises.[68]

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LPLW, AP, ML, and VW participated in the conception of this work with SNSN and SDW. LPLW wrote the first draft of the manuscript, which was refined by ML, and critically reviewed by all authors. The final draft was approved by all authors.

DISCLOSURE OF INTEREST

The authors completed the ICMJE Disclosure of Interest Form (available upon request from the corresponding author) and declared that they have no competing interests.

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