The Impact of COVID-19 on HIV Services in Kajiado County, Kenya: An interrupted time series analysis

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Abstract

Background: Globally, approximately forty million people are living with HIV, indicating HIV/AIDS is a major global public health issue. The World Health Organisation (WHO) projected that disruptions to HIV treatment caused by the COVID-19 pandemic could result in over 500,000 additional AIDS-related deaths in sub-Saharan Africa between 2020 and 2021. In recent decades, Kenya has made significant progress in HIV/AIDS care, leading to notable declines in incidence, morbidity, and mortality. However, limited data exist on the impact of the COVID-19 pandemic on HIV/AIDS care in sub-Saharan Africa.

Methodology: This was an interrupted time series study design, where aggregate monthly HIV care services data were collected from the health information systems of Loitoktok, Ongata Rongai, Kitengela sub-County Hospitals and Entasopia Health Centre in Kajiado County. The pre-COVID-19 period (June 2018 to February 2020) and the COVID-19 period (March 2020 to November 2021) were analysed.

Results: ART continuation remained stable at the beginning of COVID-19 pandemic ($p = 0.200$) and significantly increased over time ($p = 0.048$). New HIV care enrolments sharply declined at the pandemic's onset ($p < 0.001$), and HIV testing services showed a sustained decrease ($p = 0.009$). In contrast, PrEP use rose steadily throughout ($p < 0.001$).

Conclusions: In Kajiado, COVID-19 negatively impacted HIV treatment and prevention services. Decreasing trends indicated COVID-19 disruption, while increasing trends indicated that healthcare systems have successfully evolved to continue delivering HIV care despite COVID-19 disruptions.

Keywords: *HIV/AIDS, Anti-retroviral therapy (ART), COVID-19, PLWHIV*

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Introduction

Globally, approximately forty million people are living with HIV, indicating HIV/AIDS is a major global public health issue[1]. Consequently, there are several global strategies to curb new HIV infections and ensure access to treatment for those infected [2]. Providing treatment prolongs the lives of PLWH and prevents transmission, advancing progress toward ending the HIV pandemic. UNAIDS' 95-95-95 target for 2030 aims to diagnose 95% of PLWH, place 95% of those diagnosed on ART, and achieve viral suppression in 95% of those on treatment [3]. The outbreak of COVID-19 in China in December 2019 interrupted every aspect of normal life, including existing HIV treatment and Prevention [4]. Globally, WHO and CDC-recommended measures to curb COVID-19, such as quarantine, stay-at-home orders, social

distancing, mandatory masking, regional lockdowns, and the reallocation of medical resources, disrupted HIV treatment and prevention services. These measures limited access to HIV testing, hindered disease surveillance, and reduced close monitoring and administration of antiretroviral therapy (ART) [4]. In addition, the economic and psychosocial stress of self-quarantining exacerbated challenges faced by PLWHIV [5]. People living with HIV were particularly vulnerable to the challenges that contributed to the disruption of HIV treatment and prevention, compromising their health [6].

In Africa, HIV prevention, testing and treatment services have improved over the years; however, research has indicated that HIV/AIDS remains one of the leading causes of death and was responsible for 400000 deaths in 2019 [7]. There is growing concern that the interference of HIV care services has resulted in increased HIV/AIDS transmission, morbidity and HIV-related deaths [8].

A study in Botswana found that ART initiation was the most affected stage of the HIV care cascade, with a 49% reduction during the lockdown period. In addition, the number of newly diagnosed HIV-positive cases declined by 25%[9]. Moreover, a study conducted in South Africa on men who have sex with other men (MSM) and transgender population showed a decrease by 46% in weekly ART initiations [10].

Similarly, in Kenya, Kibera informal settlement, there was a 56% reduction in general uptake of HIV services, a 48% reduction in ART treatment enrolment, despite a 24% increase in PrEP uptake [11]. Furthermore, the study emphasised that socioeconomic factors, lack of food, as well as government measures to control the spread of COVID-19 affected uptake of HIV/AIDS services in the hotspot counties, necessitating the need for intensified measures to increase access to HIV/AIDS services at the onset of pandemics.

There is a paucity of data on the effect of COVID-19 on HIV care services in low and middle-income countries. This study aimed to assess trends in the utilisation of HIV services and the impact of COVID-19 on HIV prevention and treatment in selected areas in Kenya, where about 1.6 million people are living with HIV. Prolonged disruption of HIV screening and diagnosis threatens the care cascade, potentially reversing progress and increasing HIV incidence, particularly in high-burden countries in sub-Saharan Africa such as Kenya.

According to the Kenya News Agency and Kenya Corona statistics, Kajiado County recorded some of the highest numbers of COVID-19 cases at the onset of the pandemic and was designated a "hotspot" due to its proximity to Nairobi and cross-border interactions. The county is home to the Maasai, a nomadic community whose cultural practices, such as wife sharing within age groups, female genital mutilation, early marriages, and polygamy, pose high-risk factors for both HIV/AIDS and COVID-19 transmission [12].

In Kajiado County, nearly half (46%) of girls aged 15–19 have undergone female circumcision, which is four times the national rate of 12%. In addition, there is high illiteracy, reflected in only 36% of primary students transitioning to secondary school, which further limits knowledge of disease prevention and treatment [13]. These factors highlight the critical importance of HIV prevention and treatment services for residents of Kajiado County. This time series analysis of enrolment to care, ART treatment, HIV Testing Services (HTS), and PrEP utilisation will establish the impact of the COVID-19 pandemic control measures on HIV care and treatment services in this county.

Methodology

Study design

This quasi-experimental design utilising an interrupted time series analysis used routine data collected nationally by the Kenyan Ministry

of Health and the HIV care program through the District Health Information System (DHIS). This study assessed the impact of COVID-19 restrictions, implemented in Kenya in March 2020, as a public health intervention. We utilised aggregated monthly data from five health facilities: Loitoktok, Ongata Rongai, Kitengela Sub-County Hospitals, and Entasopia Health Centre. Data were analysed for the pre-COVID-19 period (June 2018–February 2020) and the COVID-19 period (March 2020–November 2021).

Sampling technique

To achieve good county geographical representation, five well-established facilities for the management of HIV were selected purposively. Patient data for all patients who attended the facilities for HIV treatment services, HIV testing and counselling and PrEP utilisation were abstracted from the DHIS.

Sample size

In Kajiado county, the district health information system (DHIS) is domiciled at the sub-county facilities, and all comprehensive care clinics (CCC) and personnel-in-charge submit a monthly report to the sub-county health record officer, where the data are uploaded to the DHIS. Aggregate monthly facility data from both study periods were extracted and analysed, including patients on ART, new HIV enrolments, HIV testing, and PrEP initiation/utilisation. A census of all available records was used, ensuring comprehensive inclusion rather than sampling.

Study population

All patients accessing ART treatment, new cases enrolled to care, HIV testing and counselling and those on PrEP utilisation or initiation in the selected facilities during the study period were included in the study with no age restrictions. Patients who accessed HIV treatment and other services from health facilities that were closed during the COVID-19 pandemic or used for quarantine and other epidemic control activities, were excluded.

Data collection tools

A standardised data abstraction tool was used to collect data on ART treatment, new HIV care enrolments, HIV testing, and PrEP utilisation. These data were downloaded from the Health Information Systems (HIS) of five selected facilities, spanning 42 months, 21 months pre-COVID-19 (June 2018–February 2020), and 21 months during COVID-19 (March 2020–November 2021). The following data were collected: time (month), monthly total number of new cases enrolled to care, cases continuing ART, total number of cases tested, and cases utilising and initiated on PrEP.

Data analysis

The data were abstracted, entered and saved on the Excel spreadsheets. The data were further cleaned and imported to STATA 17, where data analysis and visualisations were performed.

An interrupted time series analysis was conducted, enabling assessment of the intervention's impact at the population level while controlling for time-varying covariates.

The number of individuals served by each program was reported, and summary statistics on the study outcomes were described by intervention period (high-level restriction period and after high-level restriction period). An interrupted time series analysis was undertaken to assess the effect of COVID-19 on the study outcomes, which included HTC services uptake, ART treatment uptake and PrEP utilisation. A fitted Generalised estimating equations (GEE) model was used to show the change in trends in the utilisation of each of the HIV services during the study period (June 2018 to November 2021) on scatter plots. Summary data were standardised using the population estimates, and a multivariable Poisson regression model was used to quantify the effect of COVID-19 public health measures on each of the count outcomes. A multivariable Poisson regression model was used, as the outcomes were count outcomes, to estimate the effect of COVID-19 on the outcomes. The

breakpoint for the model was March 2020. From the analysis, the following were presented: the number of new cases enrolled in care, cases continuing on ART, total number of cases tested, and cases utilising and initiated on PrEP. Each model included month as a linear predictor, and COVID-19 as an intervention dummy variable and an interaction term between intervention and time to capture level change and trend change. A counterfactual was introduced into the model to assess the outcomes in the absence of COVID-19, under the assumption that in the absence of COVID-19, the number of new cases enrolled to care, cases continuing on ART, total number of cases tested, and cases utilising and initiated on PREP would remain unchanged.

Ethical approval

The study obtained ethical approval from Jomo Kenyatta University of Agriculture and Technology Graduate School - REF: JKU/2/11/HSH315-0313/2019, The Scientific and Ethics Review Unit (SERU) at the Kenya Medical Research Institute (KEMRI) – PROTOCOL NO. KEMRI/SERU/CMR/P00216-09-2022/4720, The Kenya National Commission for Science, Technology and Innovation (NACOSTI) -License No: NACOSTI/P/23/31648 and The Kajiado County Health Representative - REF: CGK/MEDICAL SERVICES/01/VOL.11/277. Participants' confidentiality was well maintained since no name or file number appeared in the data. The data were also kept under folders with a password, and only authorised individuals were granted data access.

Results

A total of 2,600 new cases were enrolled in care during the study period, with 1,494 (57.5%) in the pre-COVID period and 1,106 (42.5%) during COVID-19 (Table 1). Across the same period, 227,737 patients continued on ART, comprising 101,412 (44.5%) pre-COVID and 126,325 (55.5%) during COVID-19. Overall, 84,989 individuals were tested for HIV, of which 55,076 (64.8%) were tested pre-COVID and 29,913 (35.2%) during COVID. PrEP initiation and utilisation totalled 489 cases, with 140 (29%) pre-COVID and 349 (71%) during COVID-19.

Segmented regression interrupted time series (ITS) analysis was conducted for each service (Table 2). The models estimated changes in level and slope at the onset of COVID-19 (March 2020) compared to the pre-pandemic trend. Results are illustrated in Figures 1–4, where dots represent observed monthly counts and lines represent predicted counterfactual trends (the expected trajectory in the absence of COVID-19).

Table 1

Total Number of Cases Recorded for Different HIV Management Services

Characteristic	Overall cases (June 2018-Feb 2022)	Pre-COVID (June 2018-Feb 2020), n (%)	During COVID (March 2020-November 2021), n (%)	Difference in proportions between Pre-COVID and During COVID	P-value
New cases enrolled in care.	2,600	1,494 (57.5)	1,106 (42.5)	Diff= 0.15	p<0.001*
Number continuing on ART treatment	227,737	101,412 (44.5)	126,325 (55.5)	Diff=-0.11	P<0.001*
Total number tested	84,989	55,076(64.8%)	29,913(35.2%)	Diff=-0.01	P<0.001*
Number utilising and initiated on PrEP	489	140(29%)	349(71%)	Diff=-0.43	P<0.001*

*Using the Student's T-test

Interrupted time series analysis cases continuing on ART treatment

ART continuation, no immediate change was detected at the onset of COVID-19 (p=0.107). However, over time, there was a significant upward trend in ART uptake (p=0.048), likely reflecting adaptive measures such as multi-month dispensing and home delivery. In contrast, enrolment of new cases declined sharply by an average of 21 cases per month at the start of the pandemic (p<0.001) and failed to recover to pre-COVID levels, suggesting persistent barriers to entry (Table 2 and Figure 1).

Table 2

Segmented Regression Interrupted Time Series Analysis on HIV Linked Services from June 2018 to November 2021

Outcome		Coefficient	z	P>|z|	95 CI	
ART treatment uptake	Months before COVID-19	36.99	1.22	0.22	-22.38	96.36
	Beginning of COVID-19	473.41	1.61	0.11	-102.57	1049.38
	Months after COVID-19	21.03	1.97	0.05	.16	41.90
	Starting level of the COVID-19 T=0	4721.93	14.47	0.00	4082.23	5361.63
New number enrolled on care	Months before COVID-19	-.30	-0.67	0.51	-1.16	.57
	Beginning of COVID-19	-21.03	-4.52	0.00	-30.16	-11.91
	Months after the time of COVID-19	.24	4.49	0.00	.13	.34
	Starting level of the COVID-19 T=0	72.39	11.45	0.00	59.99	84.78
Total tested (HTS)	Months before COVID-19	56.76	1.11	0.27	-43.10	156.61
	Beginning of COVID-19	407.36	0.72	0.47	-703.52	1518.24
	Months after the time of COVID-19	-124.53	-2.61	0.01	-217.93	-31.12
	Starting level of the COVID-19 T=0	2157.06	4.07	0.00	1119.03	3195.10
PrEP initiation and utilisation	Months before COVID-19	-.60	-0.86	0.38	-1.97	.77
	Beginning of COVID-19	2.85	0.65	0.51	-5.69	11.39
	Months after the time of COVID-19	.78	3.78	0.00	.38	1.19
	Starting level of the COVID-19 T=0	8.96	2.76	0.01	2.61	15.32

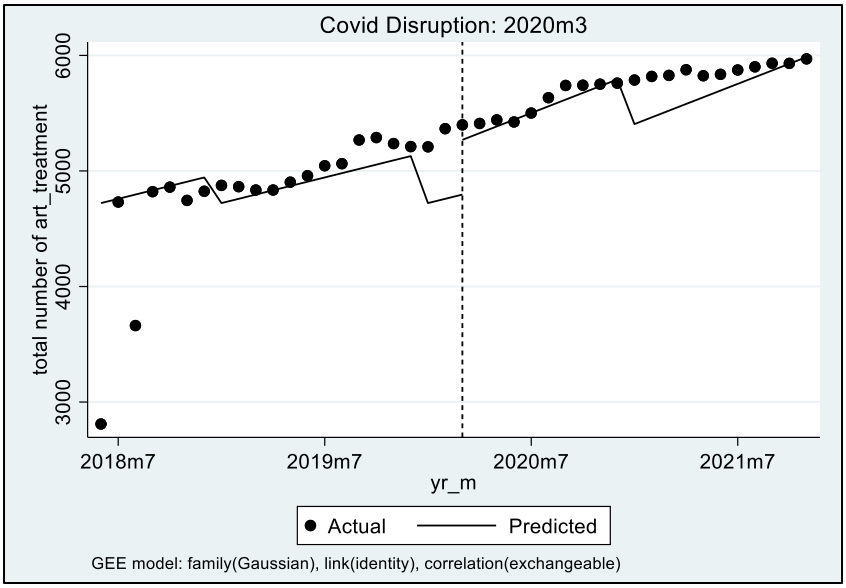

Figure 1

Fitted monthly values of ART uptake before COVID-19 (June 2018-Feb 2020) and during the COVID-19 period (March 2020-November 2021)

Interrupted time series analysis of new cases enrolled on HIV care

For the number enrolled on HIV care, we observed a sharp decline at the beginning of the pandemic, with an immediate drop by 21 cases per month ($p < 0.001$) (Table 2, Figure 2). Enrolment numbers did not return to pre-pandemic levels, reflecting persistent barriers to accessing HIV care, such as limited outreach programs and socioeconomic challenges.

Interrupted time series analysis on HIV testing

The repercussions of COVID-19 on HIV testing (Table 2, Figure 3) were alarming. Before the pandemic, the trend was consistent, showing no notable variations ($p=0.265$). Nevertheless, following the onset of the pandemic, there was a decline in HIV testing services over time ($p=0.009$). This suggests that COVID-19 restrictions and the pressure on the healthcare system significantly hindered access to testing, possibly leading to a backlog of undiagnosed HIV cases. A reduction in HIV testing may result in heightened transmission rates, delayed diagnoses, and an increased burden of untreated HIV within the community. This downturn could have been influenced by redirected healthcare resources, reduced outreach initiatives, and the apprehension regarding visiting healthcare facilities due to the risks of COVID-19 exposure.

HIV testing also declined significantly during COVID-19 ($p=0.009$), consistent with service disruptions, resource reallocation, and reduced health-seeking behaviour due to pandemic fears. Conversely, PrEP utilization increased steadily over the pandemic period ($p<0.001$), possibly driven by programmatic prioritization and increased risk perception among high-risk groups.

Interrupted time series analysis on PrEP utilisation and initiation

Interestingly, PrEP utilisation (Table 2, Figure 4) demonstrated a positive trend with a continuous increase over time ($p < 0.001$). Unlike testing and new enrolments, which were severely hampered by the epidemic, PrEP services remained available, and their utilisation increased.

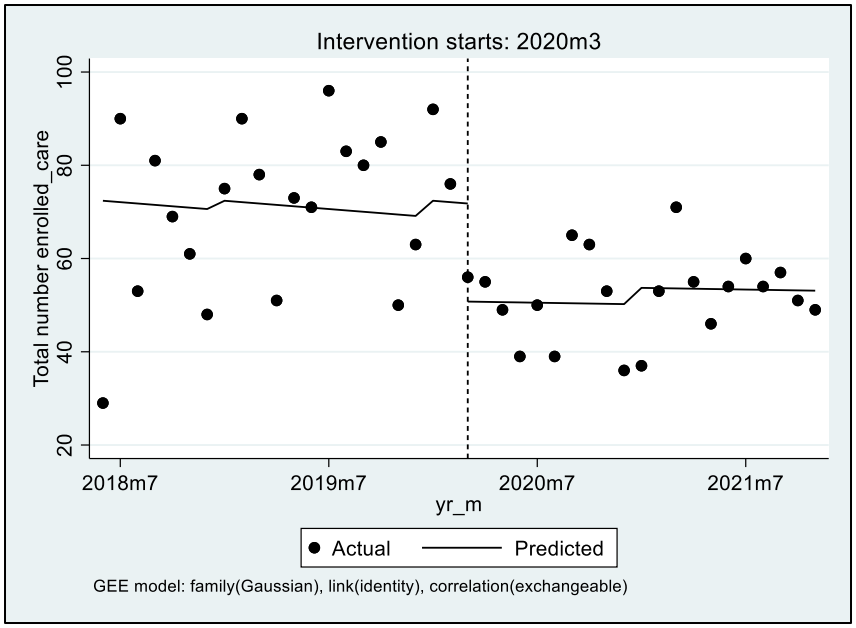

Figure 2

Fitted monthly values of new cases enrolled to care before COVID-19 (June 2018-Feb 2020) and during the COVID-19 period (March 2020-November 2021)

This shows that healthcare systems have successfully evolved to continue delivering preventive HIV care, possibly through focused awareness campaigns and long-term PrEP prescriptions.

The increased demand for PrEP during the epidemic may also reflect behavioural shifts, with high-risk individuals seeking preventive measures due to limited access to HIV therapy.

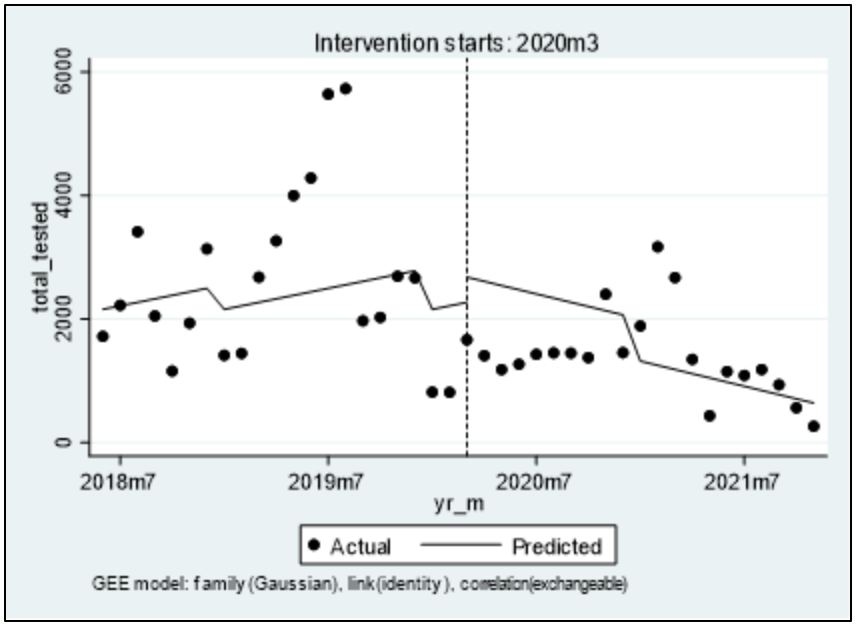

Figure 3
Fitted monthly values of the total number of people tested before COVID-19 (June 2018- February 2020) and during the COVID-19 period (March 2020-November 2021)

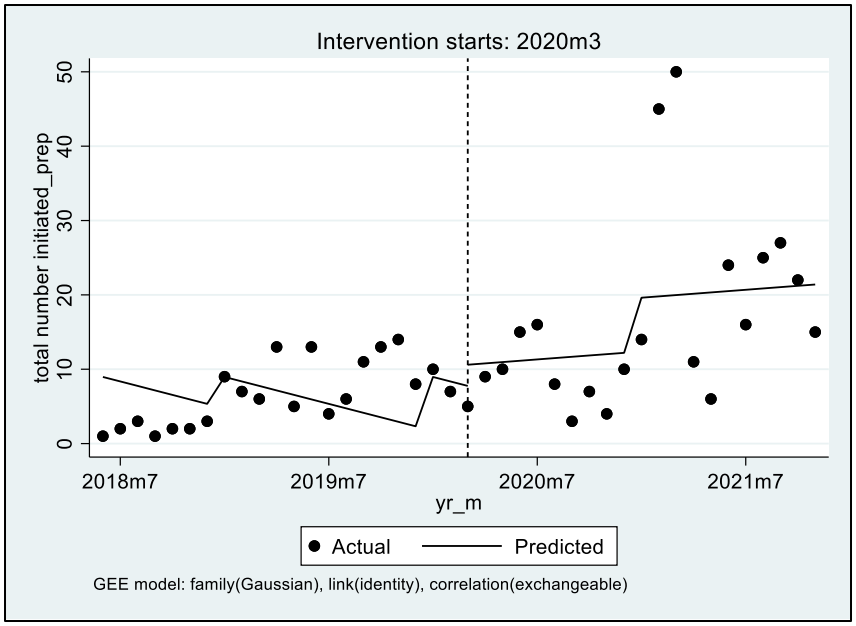

Figure 4
Fitted monthly values of cases on PrEP before COVID-19 (June 2018-Feb 2020) and during the COVID-19 period (March 2020-November 2021).

Discussion

The findings emphasise the complex effects of the COVID-19 pandemic on HIV services provision in Kajiado County, uncovering significant interruptions and aspects of resilience. The most notable difficulties were the drastic reduction in HIV testing and new enrolments into care, which reflect worldwide and regional trends of decreased healthcare access during the pandemic. Nonetheless, the ongoing administration of ART treatment and the heightened use of PrEP suggest that, despite the disruptions, vital HIV treatment and prevention services were maintained through creative healthcare adjustments. This conversation frames the results by connecting them to pertinent studies and wider public health consequences, highlighting critical areas that necessitate strategic intervention.

An interesting finding in the current study was the notable decline in new HIV enrolments to care (-15%) and HIV testing rates (-29. 6%) during the COVID-19 period. This interruption aligns with worldwide trends noted in other healthcare environments, where testing and standard HIV services were deprioritised owing to restrictions related to the pandemic and reallocation of resources. As reported by UNAIDS [14], numerous sub-Saharan African nations witnessed a 22-50% reduction in HIV testing rates due to lockdowns, anxiety about COVID-19 exposure in healthcare facilities, and the shift of medical staff towards pandemic response activities. Likewise, Jiang et al. [4] emphasised that global actions to prevent COVID-19 spread drastically restricted access to HIV testing and counselling services, thus delaying diagnoses and raising the risk of community spread.

The noted decrease in HIV testing within Kajiado County highlights a significant threat to HIV care since early detection is vital for HIV prevention and treatment approaches. According to Jewell BL, et al [8], late HIV diagnoses could result in heightened viral spread, poorer health status, and increased strain on the healthcare system. For example, Schaffer [15] found that even short-term interruptions in HIV services could have lasting consequences, with modelling data suggesting that a six-month disruption could lead to more than 500,000 additional HIV-related deaths globally. The reduction in HIV care enrolments reported in this study implies that numerous individuals who potentially tested positive did not seek care, which may lead to elevated transmission rates within the community.

In contrast to the decreases in new enrolments and testing, ART continuation rose by 11% during the pandemic, suggesting that patients already on treatment adhered to treatment despite interruptions in healthcare. This result corresponds with findings from Botswana, South Africa, and Kenya, where ART continuation rates remained stable owing to healthcare adjustments such as multi-month dispensing (MMD), telemedicine, and home deliveries [9–11]. A study by Kim et al indicated that youth on ART who transitioned to multi-month dispensing (MMD) maintained favourable outcomes regarding death, retention, adherence, immunosuppression, and viral suppression [15,16]. In South Africa, Yao et al identified that ART adherence among patients already in care was sustained through community-based medication distribution initiatives and decentralised ART refill locations [10].

The increase in ART uptake in Kajiado County indicates that Kenya's HIV program effectively ensured continuous access to ART treatment, which is in line with UNAIDS and WHO recommendations to safeguard ART treatment services during the COVID-19 pandemic [17]. Increased uptake of ART was augmented by multi-month ART prescriptions, which allowed patients to obtain medication for several months in a single visit, thus reducing the number of trips to the medical facilities,

consequently lowering COVID-19 exposure risks. In addition, community-based ART distribution enabled home delivery services by the community health volunteers and the health care workers. This supported adherence, especially for individuals in rural regions where access to healthcare facilities was difficult [18]. Moreover, digital health tools and telemedicine were used to follow up patients, which might have motivated medication adherence, as indicated by a previous study, which indicated that online consultations improved treatment, monitoring and patient engagement [19].

Despite these gains, some patients continued to face challenges in adhering to ART. Research indicates that the financial hardships during COVID-19 forced many patients to choose between purchasing food and affording transportation to healthcare facilities [8].

There was a 42% rise in PrEP usage throughout the COVID-19 pandemic, implying that HIV/AIDS preventive measures are key and were equally strengthened. This pattern concurs with findings from South Africa and Kenya, where PrEP uptake increased among high-risk groups despite disruption by the measures taken to curb the spread of COVID-19 [10,11]. The increase may be attributed to healthcare providers intensifying HIV prevention efforts in response to decreased testing and enrolment, thereby ensuring that individuals at high risk of HIV infection remained protected through sustained preventive services.

The rise in PrEP usage may also have been influenced by behavioural changes during the COVID-19 pandemic, as individuals at high risk of infection sought alternative prevention methods due to limited access to treatment services. The UNAIDS [13] has emphasised that increasing PrEP availability is important in reducing new HIV infections, more so among high-risk demographics, such as sex workers, MSM, and individuals with multiple sex partners.

Nonetheless, although the increased uptake of PrEP was a positive achievement, it is important to ensure that PrEP availability is consistent. Research has indicated that rural communities and lower-income individuals frequently encounter obstacles in accessing PrEP due to costs, stigma, and limitations within healthcare infrastructure [14]. Future efforts should concentrate on enhancing community outreach, combining PrEP with routine HIV testing services, and utilising digital health tools to maintain ongoing uptake and accessibility.

Study Limitations

The study´s strength lies in its interrupted time series analysis design, which enabled the determination of the effect of COVID-19 at different times and showed the trends in the utilisation of HIV care services. On the other hand, a few limitations should be acknowledged. To begin with, the study's generalizability is constrained since a few facilities' data were used, limiting the robustness of the multivariate analysis. The study used data from the health information system, where some of the patients' records might be missing. Moreover, the focus on Kajiado County may not capture the trends in the utilisation of HIV linked services across other counties in Kenya. Future research should capture multi-county designs to account for regional utilisation and the impact of COVID-19 on the PLWHIV.

Conclusion

Our findings reveal significant differences in the number of cases for the various HIV-linked services between the pre-COVID-19 and the COVID-19 periods. The COVID-19 pandemic derailed HIV testing and new enrolment to care as well as treatment services in Kajiado County. In Kajiado County, there was a notable increase in the number of patients on ART treatment and in PrEP utilisation. This positive trend reflects the effectiveness of targeted local interventions, like the extended ART refills and

community-based ART distribution, which have helped mitigate some of the COVID-19 pandemic effects on HIV care.

Recommendation

More studies on the effectiveness of Community-Based Interventions and HIV care models implemented during pandemics should be conducted to enable the use of these models in the management of other infectious diseases. Understanding the strengths and the weaknesses of these models will enable ways to improve and scale up in future health crises to better them.

Definition of terms

- **Total on ART**. The total number of people living with HIV who are currently receiving antiretroviral therapy (ART). ART involves taking a combination of HIV medicines daily, monthly, or every other month. While ART does not cure HIV, it enables people with HIV to live long and healthy lives and significantly reduces the risk of HIV transmission.
- **New Enrolment.** The number of people newly initiated on ART following a confirmed HIV-positive test result.
- **PrEP Utilisation.** Pre-exposure prophylaxis (PrEP) refers to the use of antiretroviral medicines by HIV-negative individuals who are at substantial risk of HIV infection, to prevent them from acquiring HIV.
- **Multi-Month Dispensing (MMD).** A differentiated service delivery approach where people receiving ART are provided with several months' supply of antiretroviral medicines (usually 3–6 months) at once, reducing the need for frequent clinic visits and prescriptions.
- **ART Adherence.** The extent to which a person takes ART medicines exactly as prescribed — including correct dosage, timing, and attending follow-up appointments — to achieve optimal viral suppression.
- **Comprehensive Care Clinic (CCC).** A specialized department or unit within a health facility that provides integrated, multidisciplinary HIV prevention, treatment, care, and support services for people living with HIV.

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Authors contribution

R.R.M: Conceptualisation, study design, data collection and analysis, and preparation of manuscript.

B. N. and K. N.: Academic oversight and supervision on methodology, data analysis and critical review of manuscript.

M.L.K.: Data collection and analysis

All authors read and approved the final version of the manuscript for submission and agreed to be accountable for all aspects of the work.

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