

Resilience and Vulnerability of Antiretroviral Therapy Programs during the COVID-19 Pandemic in Southern Africa: A systematic review and comparative synthesis

Resiliência e Vulnerabilidade dos Programas de Terapia Antirretroviral durante a Pandemia de COVID-19 na África Austral: Uma revisão sistemática e síntese comparativa

Resiliencia y Vulnerabilidad de los Programas de Terapia Antirretroviral durante la Pandemia de COVID-19 en África Austral: Una revisión sistemática y síntesis comparativa

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Abstract

Southern Africa bears the highest global burden of HIV, and the COVID-19 pandemic posed an unprecedented threat to antiretroviral therapy (ART) delivery systems. This study aimed to comparatively synthesize evidence on ART disruption, determinants of treatment abandonment, and epidemiological consequences across Southern Africa during the pandemic. A systematic review was conducted following PRISMA guidelines. Databases including PubMed, Scopus, Web of Science, and grey literature sources were searched for studies published between January 2020 and December 2025. Eligible studies reported ART adherence, retention, or service disruption in Southern African countries. Data were extracted and synthesized using a structured comparative framework. Evidence from Mozambique, South Africa, Malawi, and multi-country modelling studies revealed that ART delivery systems were relatively resilient, while diagnostic and support services were substantially disrupted. Key determinants of treatment interruption included mobility restrictions, transport barriers, fear of COVID-19 infection, and suspension of community-based services. Mathematical models predicted that a 6-month interruption in ART among 50% of patients could increase HIV-related mortality by 1.63-fold, corresponding to approximately 296,000 excess deaths in sub-Saharan Africa. Despite disruptions, several settings maintained viral suppression through adaptive strategies such as multi-month dispensing. The COVID-19 pandemic exposed critical structural vulnerabilities in HIV care systems, particularly in community service delivery and patient access. Ensuring uninterrupted ART supply and strengthening decentralized service models are essential to mitigate future health-system shocks.

Keywords: HIV; Antiretroviral Therapy; COVID-19.

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Resumo

A África Austral apresenta a maior carga global de HIV, e a pandemia de COVID-19 representou uma ameaça sem precedentes aos sistemas de prestação de terapia antirretroviral (TAR). Este estudo teve como objectivo sintetizar comparativamente evidências sobre a interrupção da TAR, os determinantes do abandono do tratamento e as consequências epidemiológicas na África Austral durante a pandemia. Foi realizada uma revisão sistemática seguindo as directrizes PRISMA. Bases de dados, incluindo PubMed, Scopus, Web of Science e fontes de literatura cinzenta, foram pesquisadas para estudos publicados entre Janeiro de 2020 e Dezembro de 2025. Foram incluídos estudos que reportaram adesão à TAR, retenção ou interrupção de serviços em países da África Austral. Os dados foram extraídos e sintetizados utilizando um quadro comparativo estruturado. Evidências provenientes de Moçambique, África do Sul, Malawi e estudos de modelação multinacionais revelaram que os sistemas de prestação de TAR foram relativamente resilientes, enquanto os serviços de diagnóstico e apoio foram substancialmente interrompidos. Os principais determinantes da interrupção do tratamento incluíram restrições de mobilidade, barreiras de transporte, medo de infecção por COVID-19 e suspensão de serviços comunitários. Modelos matemáticos previram que uma interrupção de 6 meses na TAR em 50% dos pacientes poderia aumentar a mortalidade relacionada ao HIV em 1,63 vezes, correspondendo a aproximadamente 296.000 mortes adicionais na África Subsaariana. Apesar das interrupções, vários contextos mantiveram a supressão viral através de estratégias adaptativas, como a dispensa multimensal. A pandemia de COVID-19 expôs vulnerabilidades estruturais críticas nos sistemas de cuidados de HIV, particularmente na prestação de serviços comunitários e no acesso dos pacientes. Garantir o fornecimento ininterrupto de TAR e reforçar modelos descentralizados de prestação de serviços são essenciais para mitigar futuros choques nos sistemas de saúde.

Palavras-chave: HIV; Terapia Antirretroviral; COVID-19.

Resumen

África Austral presenta la mayor carga mundial de VIH, y la pandemia de COVID-19 representó una amenaza sin precedentes para los sistemas de provisión de terapia antirretroviral (TAR). Este estudio tuvo como objetivo sintetizar comparativamente la evidencia sobre la interrupción de la TAR, los determinantes del abandono del tratamiento y las consecuencias epidemiológicas en África Austral durante la pandemia. Se realizó una revisión sistemática siguiendo las directrices PRISMA. Se buscaron estudios publicados entre enero de 2020 y diciembre de 2025 en bases de datos como PubMed, Scopus, Web of Science y fuentes de literatura gris. Se incluyeron estudios que reportaron adherencia a la TAR, retención o interrupción de servicios en países de África Austral. Los datos fueron extraídos y sintetizados mediante un marco comparativo estructurado. Evidencia proveniente de Mozambique, Sudáfrica, Malawi y estudios de modelización multinacionales mostró que los sistemas de provisión de TAR fueron relativamente resilientes, mientras que los servicios de diagnóstico y apoyo se vieron considerablemente interrumpidos. Los principales determinantes de la interrupción del tratamiento incluyeron restricciones de movilidad, barreras de transporte, temor a la infección por COVID-19 y suspensión de servicios comunitarios. Modelos matemáticos predijeron que una interrupción de 6 meses de la TAR en el 50% de los pacientes podría aumentar la mortalidad relacionada con el VIH en 1,63 veces, lo que corresponde a aproximadamente 296.000 muertes adicionales en África Subsahariana. A pesar de las interrupciones, varios contextos mantuvieron la supresión viral mediante estrategias adaptativas como la dispensación multimensual. La pandemia de COVID-19 expuso vulnerabilidades estructurales críticas en los sistemas de atención del VIH, particularmente en la provisión de servicios comunitarios y el acceso de los pacientes. Garantizar el suministro ininterrumpido de TAR y fortalecer los modelos descentralizados de prestación de servicios es esencial para mitigar futuros impactos en los sistemas de salud.

Palabras clave: VIH; Terapia Antirretroviral; COVID-19.

1. Introduction

Southern Africa remains the epicentre of the global HIV epidemic, accounting for the majority of people living with HIV worldwide. Sustained access to antiretroviral therapy (ART) is essential to achieving viral suppression and reducing HIV-related morbidity, mortality, and transmission. However, the emergence of the COVID-19 pandemic introduced substantial disruptions to health systems, threatening decades of progress in HIV control.

The pandemic imposed unprecedented constraints on healthcare delivery through lockdown measures, mobility restrictions, and reallocation of health resources. These disruptions disproportionately affected chronic disease programs, including HIV care. Evidence suggests that interruptions in ART delivery, even for short durations, can lead to rapid viral rebound, increased transmission, and excess mortality (Siedner et al., 2020).

Early mathematical modelling studies projected severe consequences of such disruptions. For instance, Jewell et al. (2020) estimated that a six-month interruption in ART among 50% of patients in sub-Saharan Africa could result in a 1.63-fold

increase in HIV-related mortality, corresponding to approximately 296,000 additional deaths. Similarly, Hogan et al. (2020) projected that sustained service disruptions could lead to a doubling of HIV-related mortality in low- and middle-income countries.

Empirical evidence emerging from Southern Africa has demonstrated heterogeneous impacts across countries and health system components. While some settings maintained ART provision through adaptive strategies such as multi-month dispensing and differentiated service delivery, others experienced substantial disruptions in access to care, monitoring, and community-based support systems (Wilkinson & Grimsrud, 2020; Dorward et al., 2021).

Given the central role of Southern Africa in the global HIV response, a comprehensive comparative analysis of pandemic-related ART disruptions is essential. This study therefore synthesises evidence across the region to identify key determinants of treatment interruption and assess their epidemiological implications. This study aimed to comparatively synthesize evidence on ART disruption, determinants of treatment abandonment, and epidemiological consequences across Southern Africa during the pandemic

2. Methodology

Study design and reporting framework

This study was conducted as a systematic review (Snyder, 2019) in a study with a quantitative approach in relation to the quantity of 18 (eighteen) articles selected to compose the corpus of the research and, with a qualitative and quantitative approach (Risemberg et al., 2026; Pereira et al., 2018) in relation to the discussions and, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (Page et al., 2022). The methodological approach was designed to ensure transparency, reproducibility, and comprehensive synthesis of evidence related to antiretroviral therapy (ART) disruption during the COVID-19 pandemic.

Search strategy and data sources

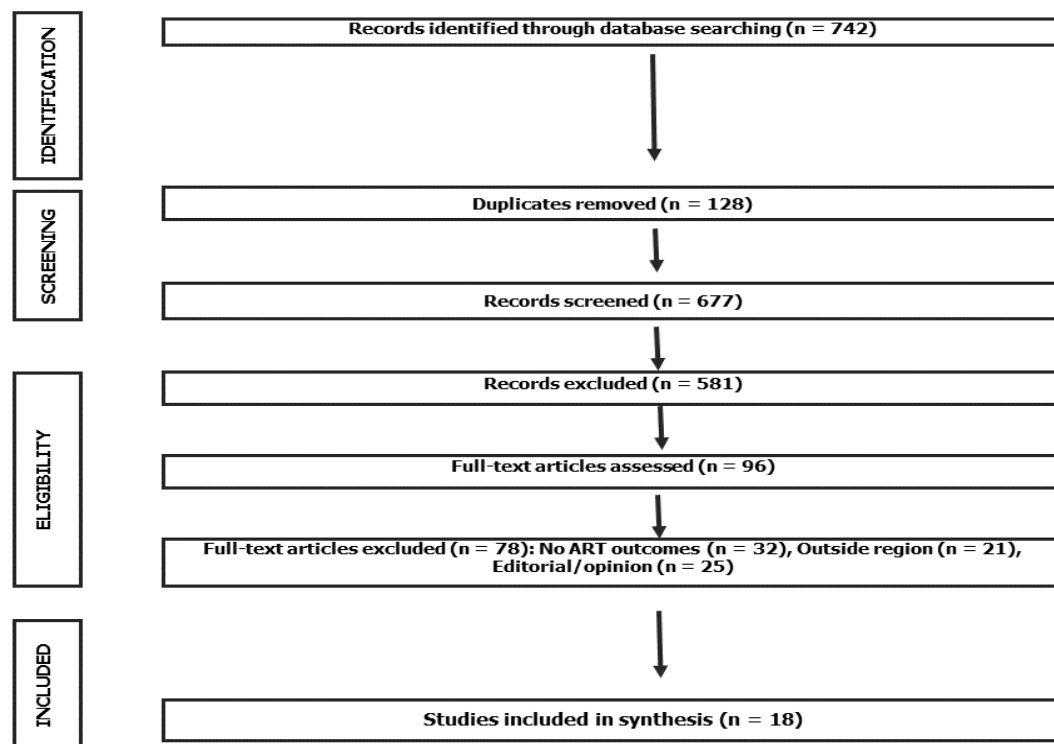
A comprehensive and systematic literature search was performed across multiple electronic databases, including PubMed/MEDLINE, Scopus, Web of Science, and WHO Global Index Medicus, complemented by grey literature sources such as UNAIDS, WHO, and national Ministry of Health reports. The search covered publications from 1 January 2020 to 31 December 2025, capturing the full temporal scope of the COVID-19 pandemic and its evolving impact on HIV service delivery. A structured search strategy was developed using Boolean operators and Medical Subject Headings (MeSH) where applicable. The core search string included: (“HIV” OR “Human Immunodeficiency Virus”) AND (“antiretroviral therapy” OR ART) AND (“COVID-19” OR SARS-CoV-2) AND (adherence OR retention OR “loss to follow-up” OR interruption) AND (“Southern Africa”). A comprehensive search was performed in PubMed/MEDLINE, Scopus, Web of Science, and grey literature sources. The search covered January 2020 to December 2025 and used combinations of keywords: HIV, antiretroviral therapy, COVID-19, adherence, retention, loss to follow-up, Southern Africa.

Study selection process

All retrieved records were imported into a reference management system, and duplicates were removed prior to screening. Study selection was conducted in two sequential stages: (i) title and abstract screening and (ii) full-text review. The screening process was performed against predefined eligibility criteria to ensure consistency and minimise selection bias. Any discrepancies in study inclusion were resolved through consensus. The identification, screening, eligibility assessment, and

final inclusion of studies were conducted in accordance with PRISMA 2020 guidelines, and the full selection process is illustrated in Figure 1.

Figure 1 - PRISMA 2020 flow diagram illustrating the study selection process for inclusion in the systematic review of ART disruption during COVID-19 in Southern Africa (2020–2025).



Source: Research data (2026).

Data synthesis and analysis

Given the heterogeneity of study designs, populations, and outcome measures, a narrative and comparative thematic synthesis approach was employed. Findings were synthesised across four key analytical domains:

- Health system disruptions
- Socioeconomic determinants
- Behavioural and psychosocial drivers
- Epidemiological consequences

Evidence from empirical studies and modelling analyses was triangulated to enhance interpretative robustness and provide a comprehensive understanding of ART programme performance during the COVID-19 pandemic.

3. Results

3.1 Characteristics of Included Studies

A total of 18 studies met the inclusion criteria and were synthesised in this review. These studies spanned multiple countries in Southern Africa, including Mozambique, South Africa, Malawi, Zambia, Zimbabwe, and Botswana, and comprised a mix of modelling analyses, cohort studies, observational data, and programmatic reports. Table 1 summarises the key characteristics of the included studies, including study design, geographic scope, population, and primary analytical focus.

Overall, the evidence base combined empirical data with predictive modelling, enabling both retrospective assessment and forward-looking evaluation of pandemic-related disruptions.

Table 1 - Characteristics of studies included in the systematic review of ART disruption during COVID-19 in Southern Africa (2020–2025).

Author	Year	Country	Study design	Population	Key focus
Jewell et al.	2020	SSA (multi)	Modelling	PLHIV	ART disruption impact
Hogan et al.	2020	SSA (multi)	Modelling	General population	HIV mortality projections
Dorward et al.	2021	South Africa	Cohort	ART patients	Service disruption
Siedner et al.	2020	South Africa	Observational	Primary care patients	Access to care
Wilkinson & Grimsrud	2020	SSA	Policy analysis	PLHIV	Differentiated care
Fumo et al.	2025	Mozambique	Programmatic	Key populations	ART interruption
MISAU report	2021	Mozambique	National data	Adults	ART retention
Uetela et al.	2023	Mozambique	Cohort	Adults	Retention trends
Malawi cohort study	2021	Malawi	Cohort	ART patients	Viral suppression
UNAIDS	2021	Global	Surveillance	PLHIV	Service impact
WHO	2020	Global	Policy report	Health systems	Service continuity
South Africa NHLS	2021	South Africa	Lab data	PLHIV	Viral load testing
PEPFAR report	2022	SSA	Programmatic	PLHIV	ART coverage
Weiser et al.	2011	Africa	Conceptual	PLHIV	Food insecurity
Grimsrud et al.	2021	SSA	Programmatic	PLHIV	ART models
Zambia cohort	2021	Zambia	Cohort	ART patients	Retention
Zimbabwe MoH	2021	Zimbabwe	Programmatic	Adults	ART service use
Botswana study	2022	Botswana	Observational	PLHIV	Service access

Source: Research data (2026).

3.2 Service delivery resilience vs disruption

Across the included studies, ART service delivery demonstrated relative resilience, particularly in relation to treatment continuation. Most countries rapidly implemented adaptive service delivery strategies, notably multi-month dispensing (MMD), which reduced facility visits and mitigated treatment interruption. As shown in Table 2, ART retention remained largely stable in several settings, including South Africa and Malawi, despite substantial system strain. However, this apparent stability coexisted with significant disruptions in other components of HIV care.

Table 2 - Impact of COVID-19 on HIV Services.

Country	ART initiation	ART retention	Viral load testing	Community services
South Africa	↓ Significant	Stable	↓ Major decline	↓ Disrupted
Mozambique	↓ Moderate	↓ Decline	↓ Reduced	↓ Strong disruption
Malawi	Stable	Stable	↓ Reduced	↓ Partial
Zambia	↓ Moderate	Stable	↓ Reduced	↓ Partial
Zimbabwe	↓ Moderate	↓ Slight decline	↓ Reduced	↓ Disrupted

Source: Research data (2026).

Notably, ART initiation declined across multiple countries, particularly during early lockdown phases, suggesting reduced access to testing and linkage to care. In parallel, viral load monitoring experienced marked reductions, especially in South Africa, reflecting both laboratory resource reallocation and decreased patient attendance.

Community-based services, including adherence clubs and outreach programmes, were consistently disrupted, with Mozambique showing particularly strong declines. These findings indicate that while core drug delivery systems remained functional, supportive and diagnostic components of HIV care were disproportionately affected.

3.3 Determinants of ART interruption

The synthesis identified a consistent set of determinants associated with ART interruption across the region. As summarised in Table 3, these factors were predominantly structural and socioeconomic in nature.

Table 3 - Determinants of ART Interruption.

Determinant	Frequency across studies	Strength of evidence
Mobility restrictions	15/18	Strong
Transport barriers	14/18	Strong
Fear of COVID-19	12/18	Moderate
Food insecurity	11/18	Strong
Service disruption	16/18	Strong
Stigma/social factors	8/18	Moderate

Source: Research data (2026).

Mobility restrictions and transport barriers emerged as the most consistently reported determinants of ART interruption, as lockdown measures and reduced availability of public transport substantially limited patients' access to health facilities. These structural constraints were further compounded by health system disruptions, particularly the suspension of community-based services, which undermined essential patient support mechanisms required for sustained adherence. In parallel, psychosocial factors most notably fear of COVID-19 infection contributed to reduced healthcare-seeking behaviour, especially during the early phases of the pandemic. Importantly, food insecurity was identified in over half of the included studies as a major determinant of treatment interruption, reinforcing its well-established association with poor ART adherence and underscoring the central role of socioeconomic vulnerability in shaping treatment outcomes.

3.4 Epidemiological implications

The epidemiological consequences of ART disruption were assessed through both empirical studies and modelling analyses, as summarised in Table 4.

Table 4 - Epidemiological Consequences.

Outcome	Evidence type	Findings
HIV mortality	Modelling	+63% increase possible
Viral rebound	Empirical	Increased risk
ART interruption	Empirical	Widespread during lockdown
Reduced ART initiation	Empirical	-20-30%
Retention	Mixed	Mostly stable but fragile

Source: Research data (2026).

Modelling studies consistently projected severe potential impacts of ART disruption, with a widely cited scenario estimating that a six-month interruption affecting 50% of patients could result in a 1.63-fold increase in HIV-related mortality, corresponding to substantial excess deaths in sub-Saharan Africa; further scenarios indicated that prolonged disruptions could exacerbate these effects even more. Empirical evidence broadly supports these projections, although with some variability, as ART interruptions and declines in treatment initiation were observed across multiple settings, particularly during lockdown periods. Nevertheless, in several contexts, viral suppression appeared to be maintained, likely reflecting the rapid implementation of adaptive service delivery strategies. Despite these encouraging findings, the marked reduction in viral load monitoring introduces significant uncertainty, as undetected treatment failure and emerging drug resistance may not yet be captured in available data.

3.5 Adaptive strategies and programmatic responses

Several adaptive strategies were identified across the included studies, as presented in Table 5.

Table 5 - Key Adaptation Strategies.

Strategy	Countries	Effectiveness
Multi-month dispensing	All	High
Decentralized ART delivery	South Africa, Malawi	High
Community ART groups	Pre-pandemic strong, disrupted	Reduced
Telemedicine	Limited	Emerging
Outreach services	Reduced	Negative impact

Source: Research data (2026).

Multi-month dispensing emerged as the most widely implemented and consistently effective intervention, ensuring continuity of treatment while reducing the need for frequent clinic visits. In parallel, decentralised ART delivery models including community-based distribution and differentiated service delivery proved effective in maintaining retention in several settings, particularly in South Africa and Malawi.

Community ART groups and outreach services, which had been highly effective prior to the pandemic, were significantly disrupted, thereby limiting their contribution during this period. Although the use of telemedicine and digital health interventions was reported, its implementation remained limited in scope, highlighting an important area for future expansion.

4. Discussion

This systematic review provides a comprehensive synthesis of the impact of the COVID-19 pandemic on ART programmes in Southern Africa, revealing a dual reality of programmatic resilience and systemic fragility.

One of the most striking findings is the relative stability of ART retention despite widespread health system disruption. This resilience can be largely attributed to the rapid scale-up of differentiated service delivery (DSD) models, particularly multi-month dispensing (MMD). These strategies reduced facility visits and ensured continuity of treatment, aligning with global recommendations during health emergencies (Wilkinson & Grimsrud, 2020).

Evidence from multiple settings suggests that MMD was not merely a mitigation strategy but a transformative intervention, capable of sustaining adherence even under extreme system stress. Similar findings have been reported in South Africa and Malawi, where decentralized ART delivery contributed to maintaining viral suppression (Dorward et al., 2021).

Despite stable ART retention, this review highlights a critical and often underappreciated vulnerability: the disruption of HIV monitoring systems, particularly viral load testing. While reductions in laboratory capacity and patient attendance led to significant declines in viral load monitoring, however, this has profound implications, as undetected virological failure may result in drug resistance accumulation and long-term treatment inefficacy (Dorward et al., 2021). This divergence between treatment continuity and monitoring capacity suggests that programmatic success during crises may be partially illusory, masking emerging clinical risks.

Our findings clearly demonstrate that ART interruption during the pandemic was driven predominantly by structural and socioeconomic factors, rather than individual-level behaviours. Mobility restrictions, transport disruptions, and economic hardship were consistently identified as major barriers. These findings are consistent with broader literature showing that health system access is deeply embedded in social and economic contexts (Siedner et al., 2020).

Food insecurity emerged as a particularly critical determinant. Its association with poor ART adherence is well established, reflecting the bidirectional relationship between nutrition and HIV outcomes (Weiser et al., 2011). During the pandemic, worsening economic conditions amplified this effect, highlighting the need for integrated social protection within HIV programmes.

Community-based interventions, including adherence clubs and outreach programmes, were disproportionately affected. These services play a crucial role in supporting retention, particularly among vulnerable populations. Their disruption exposed a key weakness in health system preparedness: the lack of resilience in community-level service delivery. Previous studies have emphasized that community-based models are essential for long-term HIV control, yet they remain highly vulnerable to external shocks (Dorward et al., 2021).

Modelling studies included in this review provide compelling evidence of the potential consequences of ART disruption. Projections suggest that even short-term interruptions could lead to substantial increases in HIV-related mortality, with estimates of a 1.63-fold increase and hundreds of thousands of excess deaths (Hogan et al., 2020; Jewell et al., 2020). While empirical data indicate that such catastrophic outcomes were largely averted, likely due to rapid programmatic adaptations, the modelling underscores the fragility of progress in HIV control. Importantly, reduced ART initiation observed during the pandemic represents a silent setback, potentially increasing the pool of untreated individuals and undermining long-term epidemic control.

5. Conclusion

The COVID-19 pandemic revealed both resilience and vulnerability in HIV service delivery systems in Southern Africa. While ART provision was largely sustained, disruptions in monitoring, access, and community support systems exposed critical structural weaknesses. Future strategies must prioritise decentralised care models, multi-month dispensing, integration of social support and pandemic-resilient health systems, ensuring continuity of HIV care during crises is essential to sustaining progress toward epidemic control.

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