Disruptions in Health Services Delivery in Côte d'Ivoire, South Africa and Uganda Due to Infection Prevention and Control Limitations in the Context of COVID-19

Project Report

November 2023

Elizabeth Glaser Pediatric AIDS Foundation
Fighting for an AIDS-free generation

epicentre
Health Research

This study was funded by the U.S. Centers for Disease Control and Prevention through the Delivering Technical Assistance (DELTA) 2 Project, CoAg # NU2GGH002211. The findings and conclusions presented are those of the author(s) and do not represent the official position of the U.S. government.

Table of Contents

Acronyms and Abbreviations

AMR	Antimicrobial Resistance
ANC	Antenatal Care
ART	Antiretroviral Therapy
CDC	United States Centers for Disease Control and Prevention
CDI	Côte d'Ivoire
COVID-19	Coronavirus Disease 2019
CSR	Centre de Santé Rurale
CSU	Centre de Santé Urbaine
DHIS2	District Health Information System 2 (health management data platform)
EGPAF	Elizabeth Glaser Pediatric AIDS Foundation
FP	Family Planning
FSU	Formation Sanitaire Urbaine
HC	Health Center
HCW	Health Care Worker
HIV	Human Immunodeficiency Virus
IPC	Infection Prevention and Control
IPC-FP	Infection Prevention and Control Focal Point
IPD	Inpatient Department
IQR	Interquartile Range
IRB	Institutional Review Board
LMIC	Low- and Middle-income Countries
MOH	Ministry of Health
NCD	Non-communicable Disease
NGO	Non-governmental Organization
ODK	Open Data Kit (software)
OPD	Outpatient Department
PPE	Personal Protective Equipment
PNC	Postnatal Care
QC	Quality Control
REC	Research Ethics Committee
SA	South Africa
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SOPs	Standard Operating Procedures
STATA	Statistics and Data (data management and statistical software)
TAT	Turnaround Time
TB	Tuberculosis
UG	Uganda
WHO	World Health Organization

Executive Summary

Introduction

The COVID-19 pandemic is disrupting health services worldwide. While data on the scope of health service disruptions during the pandemic are becoming available, the extent to which infection prevention and control (IPC) limitations or commitments in terms of resources, personnel, or policies may be contributing to these service disruptions is largely unknown. Identifying gaps in IPC implementation that have led to the disruption of health care will be critical in developing more effective IPC protocols and training and facilitating access to supplies and/or trained professionals. Also, assessing the extent of disruption during the pandemic to testing for antimicrobial resistance (AMR) in bacterial infections is crucial to be able to strengthen AMR clinical and surveillance activities.

Objectives

To determine the amount, types, and duration of health service disruptions in public health facilities in Côte d'Ivoire, Uganda, and South Africa from March 2020 – August 2021; and, in particular, the extent to which IPC limitations or gaps led to health service reductions, and document facility attendance in key service delivery areas in context of the COVID-19 pandemic. Additionally, to assess the extent to which health service disruptions may have affected reported antibiotic prescribing and testing for AMR.

Methods

The study consisted of cross-sectional surveys of potential health service disruptions in selected facilities, reported antibiotic prescribing and testing for AMR, and an analysis of routine service attendance trends over time in the selected facilities, and in relation to nationally reported COVID-19 cases. Two regions/provinces with high COVID-19 prevalence were selected in each of the three countries. A minimum of 40 facilities per country (20 per region/province) were surveyed. Public and faith-based facilities were randomly sampled by level of care (strata): primary, secondary, and tertiary, with oversampling of hospitals. The study was conducted over the period of November 2021-May 2022. Data were analyzed descriptively, using proportions, percentages, means or medians, and standard deviations and interquartile ranges where appropriate. For the open-ended questions, responses were grouped, and themes described. Data were also displayed in charts and graphs. The study was reviewed and approved by CDC, Institutional Review Boards (IRBs)/Research Ethics Committees in the three countries, and by the US-based Advarra IRB, as non-human subjects' research.

Results

At least 70% of health facilities surveyed in the three countries reported at least one service disruption; among which over 80% of which were IPC-related. Disruption occurred across almost all health service delivery areas, with antenatal care (ANC) being particularly affected. Limiting patient volumes were the most frequently reported service disruptions, followed by reductions in service staff and service hours in Uganda and Côte d'Ivoire, and service suspension and reductions in service scope in South Africa. The overall severity of disruption was low-to-moderate (<50% services disrupted). Ward closures had the longest median disruption time in South Africa and Uganda, 46 weeks, and 20 weeks respectively, though in Côte d'Ivoire, the median disruption

time was three weeks. The most reported reasons for service disruption overall were implementing IPC directives, COVID-19 illness among patients and among staff, and implementing social distancing measures. Many of the IPC directives were focused on limiting patient volumes, suspending services and social distancing measures. Insufficient staff, lack of space for patient isolation, lack of testing equipment, supplies and PPE, and non-compliant patients were the reported constraints in the identification and isolation of patients.

Concerning antibiotic dispensing, hospital pharmacist interviews suggested increased use of antibiotics in 2020 compared with 2019 in South Africa and Uganda, but mixed views in Côte d'Ivoire. There was no reported increase in the use of antibiotics for multi-drug resistant bacteria over this time.

AMR testing was disrupted by the COVID-19 pandemic in both South Africa and Uganda. South African laboratory directors reported increased workloads and longer turnaround times (TATs) in antimicrobial susceptibility results in 2020 compared with 2019. Ugandan respondents, however, reported decreased workloads (fewer clinical cultures), fewer screening cultures and reduced ability to carry out routine quality management activities and molecular testing for multidrug resistant organisms. There was less availability of reagents/consumables, and reduced supplies. Training and mentorship were less or had shifted to virtual activities. There were no changes in overall funding/budget availability.

Attendance by service delivery point for HIV testing, ART initiation, cervical cancer, and tuberculosis (TB) screening declined with the waves of COVID-19 confirmed cases in South Africa. ART care continuation however, remained constant. In Uganda, attendances by service delivery points for ANC, immunization, hypertension, and diabetes were negatively associated with the COVID-19 waves, particularly the second wave. Similarly, attendance by service delivery points for ANC, HIV care, hypertension, diabetes care, malaria, TB, and outpatient department were negatively associated with COVID-19 waves in Côte d'Ivoire.

Conclusion

Further investment in IPC measures and capacity will be key to preventing disruption in future disease pandemics. The disruptions of ANC, immunization, TB, and HIV care services could lead to increased risks of mortality and morbidity for mothers, infants, children, and the potential for TB and HIV transmission. Efforts should be made to mitigate the effects of these disruptions. Additionally, protecting healthcare personnel is a priority to prevent staff shortages and absences. The reported increase in antibiotic use should be evaluated and carefully monitored, and laboratory systems should be strengthened.

Introduction

Infection Prevention and Control (IPC) processes and procedures (including disinfection and environmental cleaning, monitoring of healthcare personnel for adherence to IPC best practices, and ensuring injection safety) within healthcare facilities are critical to prevent excessive morbidity and mortality associated with hospital-acquired infections, antimicrobial resistance, and the increasing threats posed by epidemics/pandemics. These IPC processes and procedures are often limited or lacking in Low- and Middle-Income Countries (LMICs) without strong healthcare infrastructure and resources.

The current SARS-CoV-2 pandemic presents significant challenges in health services delivery globally, with particular concern in LMIC settings where the national services may not have the capacity to scale up IPC measures rapidly at the healthcare facility level to mitigate the spread of SARS-CoV-2 and manage those that are infected. This may lead to decisions to reduce or change provision of health services that may jeopardize essential medical care such as HIV treatment and prevention, childhood immunizations, antenatal care (ANC), and other key services, such as antimicrobial resistance (AMR) surveillance. For example, a recent World Health Organization (WHO) survey of 105 countries found that 32% reported disruptions in HIV treatment services, and one in six reported severe disruption of routine immunization services (1). Over 50% of countries reported partial disruptions of ANC services. A WHO AMR Collaborating Centres Network survey on the effects of COVID-19 on AMR surveillance, prevention, and control among 73 countries found that 67% reported decreases in the ability to work with AMR partnerships, with funding decreases particularly in LMIC, 64-71% reported reduced availability of qualified health staff for AMR, and nearly 60% experienced shortages in reagents/consumables (2).

Reduced health care during the pandemic may have been the result of factors inside and outside of the health facilities. Factors outside the facilities include reduced patient demand for healthcare (often due to fear of acquiring COVID-19), disruptions to transportation services, and lockdowns. In addition, national SARS-CoV-2 mitigation strategies such as travel restrictions, home or institutional quarantine, and administrative limitations in non-essential services may affect the ability of healthcare facilities to deliver services and of patients to access services.

Health service disruptions due to facility-based factors include changes in policies and procedures that result in reduced availability of healthcare. These may include facility closures, reduced days and/or times of services, or cancelation of scheduled activities such as elective surgeries, immunization outreach, and family planning services (3, 4, 5). Others may include transfer of patients to different facilities or community services delivery sites, shifts in patient triage that changes patient flow and reduces care delivery or changes in staffing coverage due to COVID-related illness, redeployment to the COVID-19 response, or concern about infection risk. Decisions to alter the provision of health services may be driven by limitations in IPC supplies, protocols and/or trained staff. For example, insufficient personal protective equipment (PPE) for healthcare workers could result in reduced days/times for services, cancelation of elective surgeries, or shortage of healthcare workers.

Data on the amount, types, and duration of service disruptions during the SARS-CoV-2 pandemic, the extent to which IPC limitations or commitment in terms of resources, personnel, or policies may be contributing to these service disruptions, and the numbers and types of patients who are affected by these changes and are not accessing care are largely unknown. Identifying gaps in the implementation of IPC is critical, particularly if these have led to the disruption of essential and non-essential healthcare. Information on these gaps will be used to enhance the IPC preparedness and response through setting priorities for country support for improved IPC protocols and standard operating procedures (SOPs), training, IPC supplies, or other needed areas.

Study Objectives

Main objective

To assess the extent to which IPC limitations and gaps in terms of resources, personnel, or policies may have contributed to health service disruptions in the context of the COVID-19 pandemic, as well as the extent to which AMR testing may have been disrupted, between March 2020 and August 2021.

Specific objectives

1. To determine the percentage of health services modified or disrupted due to the COVID-19 pandemic, and to describe the types and duration of these disruptions within participating facilities.
2. To describe the frequency of service disruptions reported to be driven by IPC limitations or commitments versus non-IPC-related reasons.
3. To describe the specific types of service disruptions reported to be driven by IPC limitations or commitments in terms of policies, resources, or supplies, IPC training, availability of PPE, available staff, SARS-CoV-2 exposure procedures and others.
4. To estimate the potential contribution of IPC-related service disruptions on facility attendance across different service delivery points such as outpatient department (OPD), ANC, facility deliveries, childhood immunization clinic, HIV clinic, tuberculosis (TB) clinic and other non-communicable disease clinics (diabetes, hypertension, etc.).
5. To describe the extent to which AMR clinical testing may have been disrupted due to the COVID-19 pandemic.
6. To describe any changes in the prescription of antibiotics during the first year of the pandemic compared to the year prior.

Study Setting

The study was carried out in regions/provinces of South Africa, Uganda, and Côte d'Ivoire that have recorded high incidence of confirmed cases of COVID-19. These countries were selected as they represent different African regions (Southern, East, and West), speak English or French, and except for South Africa, where EGPAF has a country office.

As of June 14, 2021, South Africa had recorded nearly half of all the cases in the WHO Africa Region: 1,752,630 cumulative cases (48% of all the cases in the region), with an attack rate of 3,091.19 per 100,000 population. Uganda reported 63,099 cumulative cases (1.73% of all the cases in the region), with an attack rate of 128.64 per 100,000 population. Côte d'Ivoire had 47,760 cumulative cases (1.31% of all the cases in the region), with an attack rate of 186.57 per 100,000 population,

(https://who.maps.arcgis.com/apps/dashboards/0c9b3a8b68d0437a8cf28581e9c063a9).

In South Africa, as of June 17, 2021, Gauteng and KwaZulu-Natal provinces recorded the highest and second highest number of cumulative confirmed COVID-19 cases of 529,873 (3,491/100,000 population), and 345,105, (3,057/100,000 population) [https://www.covid19sa.org/provincial-breakdown]. The most affected Ugandan sub-regions as of June 17, 2021, were Kampala with 37,030 cumulative confirmed cases (2,486.74/100,000 population), and South Buganda with 8,212 cumulative confirmed cases (145.56/100,000 population) [Ministry of Health (MOH) Uganda]. The two most affected regions in Côte d'Ivoire were Abidjan 1 and Abidjan 2, with a total of 14,990 cumulative confirmed cases of COVID-19, (250/100,000 population) as of June 15, 2021 [MOH Côte d'Ivoire]

Methods

Study Design

This was a descriptive study consisting of surveys in selected facilities, and an analysis of routine service attendance trends over time in the selected facilities. The WHO IPC guidelines and other materials informed the development of the survey questionnaire (1, 6, 7, 8). Prior to data collection, the survey questionnaire was pretested in a selected site, and adjustments made accordingly. For Côte d'Ivoire, the questionnaire was translated into French. Study teams were trained in the protocol and on the data collection procedures and logistics in four-day training workshops. All study team members were certified in research ethics. To estimate the prevalence of service disruptions, we conducted a quantitative survey of selected health facilities in the three countries through phone or in-person interviews with the administrative heads/hospital directors/medical superintendents (or their designee) of these facilities using a structured questionnaire. Information collected included dates and types of disruption of or reduction in the delivery of health services, such as facility or hospital ward closures, scope, and suspension of services, decreased hours of operation, changes in staffing or patient processes, and shifts in patient services to other facilities or community venues, from February 2020. In addition, data were collected on the decisions for these disruptions/changes, including whether they were IPC-related or not. Using a Likert scale, hospital directors were asked to rate how the types of patient admissions/visits in the hospital changed in 2020, compared with 2019, from much less to much more. The types of admissions/visits enquired about were chronically ill inpatient admissions, intensive care unit admissions, OPD visits, emergency department visits, hospital length of stay, occupancy rate of intensive care unit beds, and non-urgent or elective surgical procedures. Data were also collected on number of inpatients, maternity and intensive or critical care beds, OPD visits, total inpatient stays, and maternity inpatient stays by year 2019-2021.

In facilities that reported IPC-related service disruptions, IPC focal points (IPC-FPs) were interviewed to obtain more information focusing on specific IPC policies, procedures, resources, and supplies. IPC-FPs were individuals in each facility whose role was to oversee IPC at that facility. Using a structured questionnaire, the IPC-FP were asked about, for example, actions taken in response to cases of COVID-19 among staff and patients, availability of PPE and other commodities, and other changes made to the delivery of services in their facility. See questions on IPC-related reasons for service disruption below.

Definitions of disruptions:

Limiting patient volume - facility ever limited patient volumes receiving services since February 2020 due to COVID-19.

Service staff reduced - facility ever reduced the number of staff providing a healthcare service since February 2020 due to COVID-19.

Service suspension – facility ever stopped or no longer offered services since February 2020 due to COVID-19.

Service scope reduced – facility ever narrowed the breadth of a healthcare service since February 2020 due to COVID-19.

Service hours reduced – facility ever reduced the hours that a healthcare service is delivered since February 2020 due to COVID-19.

Inpatient ward closures – facility ever closed any inpatient wards since February 2020 due to COVID-19.

Facility closure - facility ever closed since February 2020 due to COVID-19.

IPC-related reason for service disruption	Questions related to service disruptions
Service disrupted as per national/regional/district MOH IPC-related directives. (e.g., social distancing measures, suspension of services, limiting of patients, facility disinfection procedures.)	- actions taken to mitigate the disruption
Health personnel shortages due to COVID-19 illness or fear of illness	- ways in which health personnel could have been exposed to COVID-19 in the facility - staff cadres that had experienced shortages for this reason - whether staff deployed from other units to keep services running as normal within the same facility - whether staff deployed to other health facilities, to keep services there running as normal - planned actions to reduce staff absences due to COVID-19 illness or exposures
Lack of PPE	- availability of different types of PPE - use of an inventory - use of a calculator to estimate "burn" rates - PPE ordering process - main supplier of PPE - strategies to conserve PPE
Shortages of IPC related equipment or supplies other than PPE (e.g., sterilization equipment, disinfectants, water, waste disposal, barriers)	- availability of various types of equipment and supplies

Lack of hand washing stations	- availability of hand washing station components
Inability to identify and isolate patients and staff for COVID-19	- patient and staff screening, triaging, and testing procedures for COVID-19 - reasons for not screening triaging and testing - actions taken for patients and staff testing COVID-19 positive
Additional time needed to implement IPC procedures	- details on specific procedures implemented - reasons for needing additional time
Implementation of social distancing requirements to reduce the risk of infection	- types of social distancing implemented - actions taken to mitigate the disruption
Facility was unable to implement social distancing requirements to reduce the risk of infection	- reasons for inability to implement distancing measures - actions taken to mitigate disruption

The questionnaire also included open-ended questions on challenges, mitigation policies, practices, and resources for reported IPC-related gaps and limitations, as well as policies, practices, and resources that may reduce the likelihood of these gaps and limitations. As a check on the likelihood of service disruptions reported by facility administrators being IPC related, IPC-FPs were asked about the prevalence and types of service disruptions.

Using a structured questionnaire, interviews were also held with the facility pharmacist on changes in antibiotic use in 2020, compared with 2019 (pre-COVID-19), on a Likert scale from much less to much more. The changes asked about were: total prescribing of antibiotics, availability of antibiotics (supply chain), use of first/second line antibiotics for common infections (WHO access – lower resistance potential), use of antibiotics for limited group of syndromes (WHO watch – higher resistance potential/critically important), use of antibiotics for multi- or extensively drug resistant bacteria (WHO reserve – "last resort"). Similarly, interviews with a structured questionnaire were held with directors or managers of AMR laboratories on AMR clinical testing pre-COVID-19 (2019) and during the epidemic. Using a Likert scale, (much less/reduced/longer time/lower, to much more/significantly increased/shorter time/higher, as appropriate), questions included diagnostics and testing, availability of laboratory supplies and equipment, laboratory staff for AMR activities, training and mentorship, including quality control for staff, IPC practices and supplies, overall antimicrobial resistance, budget availability, AMR data information systems, and prioritization of AMR by the MOH. Laboratory directors were further asked about the number of samples collected, processed in the laboratory, and sent out for testing, February 2019-January 2020, as compared with February 2020-January 2021.

To estimate the potential contribution of IPC-related service disruptions on facility attendance across the various service delivery points, we extracted the aggregate patient attendance data for the surveyed facilities from the national DHIS2 systems by month from January 2019 to December 2021. This time included the pre-COVID-19 period (January 2019-February 2020), and March 2020- December 2021, which included waves of COVID-19. These data were

disaggregated by selected service areas such as ANC, OPD, inpatient department (IPD), maternity, HIV, TB, surgery, and non-communicable diseases (NCD), and where possible, by primary, secondary and tertiary levels of care.

As a check on the reporting of facility data, for example, the number of in- and out-patient attendance, hospital bed stays, etc., data collectors reviewed copies of the records of these data in a subset of four facilities per region/province (10%).

Country study teams worked with the MOH/district/regional/provincial health management teams to sensitize the facilities about the study. Trained research assistants conducted the interviews and collected the attendance data, which were captured on tablets with an OpenDataKit (ODK) version 3 database. The database was programmed with logic checks and filters to reduce error. Data were uploaded to the EGPAF server in Washington, DC. Data were collected from January to May 2022 in all three countries.

Sampling and sample size

Study facilities were selected through modified stratified sampling of health facilities in the preselected counties and regions in Côte d'Ivoire, South Africa, and Uganda. The strata consisted of the type of facility: primary, secondary, and tertiary health facilities. As the focus was on hospitals, all eligible hospitals in Côte d'Ivoire and Uganda were selected, and a random selection of lower-level facilities (at secondary and primary levels) was made. Due to its larger number of hospitals, all tertiary-level hospitals (central/regional/provincial hospitals), in South Africa were selected, while secondary-level (district hospitals) and primary-level facilities (clinics and health centers) were randomly selected. Public and faith-based facilities were eligible for inclusion. Academic, private-for-profit and non-government facilities were excluded as access to data might not have been feasible in these essentially private health facilities. Appendix 4 lists the selected facilities. A minimum sample of 40 facilities per country was sought, 20 from each region/province or sub-district.

Analysis

The type, frequency, and duration of overall service and IPC-related disruptions were described using proportions, medians (with interquartile ranges), and means (with standard deviations), as appropriate. The reasons, and mitigating actions taken, for IPC-related disruptions were similarly described. We quantified the number and percent of facilities with SARS-CoV-2 pandemic related service disruptions, as well as the types and durations of disruptions, overall, and stratified by country, region/county, level of facility and type of service. Using proportions, we estimated the extent of agreement between the facility director and IPC-FPs on the overall service disruptions. If agreement was found to be >85%, we would proceed to use the directors' responses on types and duration of disruption. If the agreement was found to be ≤85%, we would utilize the IPC-FP responses.

For the open-ended questions, we grouped responses and described themes on reported challenges, helpful policies and practices mitigating the challenges, and policies and practices that may mitigate future challenges, on IPC-related reasons for disruption such as health personnel shortages, shortages of PPE, and equipment and supplies, screening, triaging and

isolation of patients, staff illness, and implementing of social distancing. From responses by the facility directors, we described the proportion reporting change in the types of facility patient admissions/visits in 2020 compared with 2019 (much/somewhat more or much/somewhat less, and about the same). We similarly described the proportions reporting change in antibiotic use in 2020 compared with 2019 reported by the pharmacist, and the laboratory directors reporting change in AMR activities (much/somewhat more or much/somewhat less, and about the same).

Ethical Considerations

The study was reviewed and approved by the following Research Ethics Committees (RECs)/Institutional Review Boards (IRBs): the MOH Le Comité National D'ethique Des Sciences De La Vie Et De La Santé in Côte d'Ivoire, the University of KwaZulu-Natal Biomedical REC in South Africa, the Makerere University School of Public Health REC in Uganda, and the US-based Advarra IRB, as non-human subjects' research. CDC also reviewed and approved the protocol. Participants were not renumerated or given an incentive to participate. All responses are stored anonymously and kept confidential.

Results

Description of Sampled Facilities

In South Africa, data were collected from 43 health facilities: 9 (21%) tertiary level care facilities (central and provincial hospitals), 16 (37%) secondary level care facilities (district hospitals) and 18 (42%) primary level care facilities (health centers/clinics). All the health facilities provided outpatient services, 94% of which were HIV and TB services (Table 1). In-patient services were provided in 28 (65%) facilities; 86% (n=24) of these facilities offered maternity services, and 24 had medical wards. Community outreach services were provided by 34 (79%); of these 79% were HIV and TB contact tracing and treatment services.

In Uganda, data were collected from a total of 46 healthcare facilities: 25 (54%) tertiary level care facilities (national and district hospitals), 10 (22%) secondary level care facilities (Health Center (HC) IV), and 11 (24%) primary level care facilities (HC III). In-patient services were provided in 33 (72%) facilities, all of which had medical wards, and 91% (n=30) provided surgical services. Forty-five (98%) facilities offered outpatient care, including routine immunization, HIV and TB services. Community outreach services were provided by 43 (93%) facilities; all of these had HIV contact tracing and treatment services, 42 (98%) provided immunization services, and 40 (93%) had TB contact tracing and treatment services.

In Côte d'Ivoire, data were collected from 40 health facilities: 12 (30%) tertiary level care facilities (hospitals), 23 (58%) secondary level care facilities (medical centers/urban health units (Formation Sanitaire Urbaine [FSU])), and five (12%) primary level care facilities (health centers/clinics (Centre de santé urbaine/Centre de santé rurale) [CSU/CSR]). In-patient services were provided in 16 facilities (40%), 15 offering maternity services and medical wards. Just over half of the 16 facilities with in-patient services (n=9) had surgical services. All the 40 sampled facilities had out-patient services, which included HIV care services (98%, n=39), antenatal and postnatal care (PNC) services (93%, n=37), and routine immunization (85%, n=34). Community outreach services were provided by 32 facilities (80%), with 27 (84%) providing HIV contact tracing.

Table 1: Services provided at study health facilities: South Africa (SA), Uganda (UGA), Côte d'Ivoire (CDI)

	SA (n=43)	UG (n=46)	CDI (n=40)
	N (%)	N (%)	N (%)
In-patient services	**28 (65)**	**33 (72)**	**16 (40)**
Maternity services	24 (86)	29 (88)	15 (94)
Medical wards	24 (86)	33 (100)	15 (94)
Mental health wards	19 (68)	10 (30)	4 (25)
Emergency surgical services	22 (79)	30 (91)	9 (56)
Non-emergency surgical services	23 (82)	30 (91)	9 (56)
Other inpatient services	28 (100)	4 (9)	0 (0)
Out-patient services	**43 (100)**	**46 (100)**	**40 (100)**
Antenatal care services	39 (91)	43 (96)	37 (93)
Postnatal care services	34 (79)	41 (89)	37 (93)
Family planning and contraception	40 (87)	41 (89)	33 (83)
Routine immunization	33 (72)	45 (100)	34 (85)
Under-Five clinics	34 (74)	35 (78)	33 (83)
HIV prevention, diagnosis, and treatment	43 (94)	45 (100)	39 (98)
TB case detection and treatment	43 (94)	45 (100)	25 (63)
Cancer screening and diagnosis	37 (80)	40 (89)	12 (30)
Non-communicable disease services	42 (91)	45 (100)	20 (50)
Acute care services	42 (91)	40 (89)	12 (30)
Mental health services	39 (85)	37 (82)	4 (10)
Rehabilitation services	37 (80)	20 (44)	6 (15)
Nutrition services	41 (89)	36 (80)	29 (73)
24-hour emergency care	32 (70)	35 (78)	14 (35)
Other outpatient services	25 (54)	24 (53)	19 (48)
Community outreach services	**34 (79)**	**43 (94)**	**32 (80)**
Maternal and Child Health services	17 (50)	36 84)	6 (19)
Immunization	19 (56)	42 (98)	17 (53)
TB contact tracing and treatment	27 (79)	40 (93)	12 (38)
HIV contact tracing and treatment	27 (79)	43 (100)	27 (84)
Community-based mobile clinics	13 (38)	5 (12)	3 (9)
Other community outreach services	15 (44)	5 (12)	6 (19)

Table 2 presents the service capacity and volumes for 2019-2021. Except for inpatient beds in South Africa, which recorded a 5% increase in median bed capacity in 2021 compared to 2019, there was no change in maternity or critical/intensive care beds. Median inpatient admissions declined by 13% in 2021, compared to 2019. There were declines in median maternity stays and outpatient visits of 7% and 25%, respectively, in 2021 compared to 2019.

In Uganda, the median number of beds remained the same from 2019-2021. Inpatient admissions declined by 30% in 2021 compared with 2019. Median maternity stays declined 22% in 2021 compared with 2019. Outpatient visits declined 29% in 2021 relative to 2019.

The median number of beds remained the same over the years 2019-2021 in Côte d'Ivoire, while the inpatient admissions increased 72% in 2021 compared with 2019. The median number of maternities stays also increased over these years. Compared with 2019, median stays were 81% higher in 2021. Similarly, outpatient visits increased year-on-year, and were 24% higher in 2021 compared to 2019.

Table 2: Inpatient and outpatient capacity and service volumes, 2019-2021, (median and interquartile range (IQR)): South Africa, Uganda, Côte d'Ivoire

Number of:	Year	SA Median (Q1*, Q3*)	UG Median (Q1*, Q3*)	CDI Median (Q1*, Q3*)
Inpatient beds	2019	264 (105, 445)	60 (22,175)	18 (7, 40)
	2020	272 (121, 445)	60 (22, 175)	18 (9, 55)
	2021	277 (121, 436)	60 (22, 176)	18 (9, 55)
Maternity beds	2019	33 (10, 59)	16 (10, 33)	8 (2, 12)
	2020	30 (10, 59)	16 (10, 33)	8 (2, 19)
	2021	30 (10, 59)	16 (8, 33)	8 (2, 19)
Critical or intensive care beds	2019	0 (0, 7)	0 (0, 1)	0 (0, 0)
	2020	0 (0, 8)	0 (0, 1)	0 (0, 4)
	2021	0 (0, 9)	0 (0, 4)	0 (0, 4)
Inpatients admitted	2019	17,329 (3,593, 56,736)	2,819 (538, 7,820)	1,266 (511, 2,732)
	2020	17,522 (6,739, 53,586)	2,947 (600, 6,352)	1,519 (579, 2,634)
	2021	15,055 (7,386, 63,988)	1,985 (360, 4,402)	2,175 (921, 3,690)
Maternity stays	2019	4,757 (628, 11,882)	1,716 (300, 4,635)	655 (22, 1949)
	2020	5,105 (196, 12,681)	2,061 (360, 3,995)	1,083 (60, 2,049)
	2021	4,428 (667, 8,005)	1,343 (240, 2734)	1,189 (152, 2,534)
Outpatient visits	2019	58,029 (26,116, 130,561)	26,101.5 (12,963, 55,140)	17,254 (6,173, 45,852)
	2020	48,982 (24,445, 113,696)	24,125 (12,336, 42,621)	18,427 (5,158, 2,796)
	2021	43, 648 (14,516, 81,909)	18, 656 (9,332, 36,066)	21,346 (6,819, 50,813)

*Quartiles

Hospital Directors reported change in types of hospital patient admissions/visits 2019-2020

The hospital directors' responses on a Likert scale on how the types of patient admissions/visits had changed in 2020, compared to 2019, are summarized in Table 3. About 88% (n=21) of the South African directors reported that non-urgent surgical procedures were somewhat/much less in 2020 compared to 2019, 76% (n=19) said outpatients visits were less, 61% (n=17), reported that emergency department visits were somewhat less/much less, and 52% (n=13) that chronically ill inpatient admissions were less/much less. The directors reported that hospital admissions and visits reported to be somewhat/much more in 2020 compared to 2019 were the

bed occupancy rate in intensive care units, 70% (n=12 directors), hospital lengths of stay, 68% (n=17 directors), and intensive care admissions 50% (n=8 directors).

Uganda directors reported that compared to 2019, in 2020 admissions for chronically ill patients were somewhat/much less, 57% (n=16 directors), while intensive care admissions were somewhat/much more, 71% (n=10 directors), as was the occupancy rate of intensive care unit beds, 67% (n=8 directors). Outpatient visits were somewhat/much less, 86% (n=25 directors), as were emergency department visits, 64% (n=18 directors) and elective surgeries, 84% (n=22 directors). Comments were split on hospital lengths of stay; 35% (n=10 directors) said it was about the same, while 38% (n=11 directors), said that it was somewhat/much less.

In Côte d'Ivoire, 6 of 12 directors reported that compared to 2019, in 2020 chronically ill patient admissions were somewhat/much less, and 4 of the 7 directors who responded, also reported that intensive care admissions were much less.

Table 3. Reported change in the types of hospital patient admissions/visits in 2020 compared with 2019, South Africa, Uganda, and Côte d'Ivoire.1

	SA	UG*	CDI
	N (%)	N (%)	N (%)
Chronically ill inpatient admissions	**(n=25)**	**(n=28)**	**(n=12)**
Much more	8 (32)	3 (11)	-
Somewhat more	-	3 (11)	1 (10)
About the same	4 (16)	6 (21)	4 (40)
Somewhat less	4 (16)	5 (18)	2 (20)
Much less	9 (36)	11 (39)	3 (30)
Missing	-	-	2
Intensive care unit admissions	**(n=16)**	**(n=14)**	**(n=7)**
Much more	6 (38)	7 (50)	-
Somewhat more	2 (13)	3 (21)	1 (14)
About the same	3 (19)	2 (14)	2 (29)
Somewhat less	2 (13)	-	-
Much less	2 (13)	2 (14)	4 (57)
Do not know	1 (6)	-	-
Outpatient visits	**(n=25)**	**(n=29)**	**(n=12)**
Much more	4 (16)	1 (3)	-
Somewhat more	2 (8)	1 (3)	4 (33)
About the same	-	2 (7)	2 (17)
Somewhat less	7 (28)	8 (28)	2 (17)
Much less	12 (48)	17 (59)	4 (33)
Emergency department visits	**(n=25)**	**(n=28)**	**(n=12)**
Much more	7 (28)	4 (14)	-
Somewhat more	1 (4)	4 (14)	2 (17)
About the same	1 (4)	2 (7)	6 (50)
Somewhat less	2 (8)	10 (36)	1 (11)
Much less	14 (56)	8 (29)	2 (22)
Missing	-	-	1

Hospital length of stay	**(n=25)**	**(n=29)**	**(n=12)**
Much more	14 (56)	4 (14)	-
Somewhat more	3 (12)	4 (14)	2 (17)
About the same	1 (4)	10 (35)	6 (50)
Somewhat less	-	10 (35)	4 (33)
Much less	7 (28)	1 (3)	-
Occupancy rate of intensive care unit beds	**(n=17)**	**(n=12)**	**(n=7)**
Much more	11 (65)	4 (33)	-
Somewhat more	1 (6)	4 (33)	-
About the same	3 (18)	1 (8)	2
Somewhat less	-	2 (16.7)	1
Much less	-	1 (8)	1
Do not know	2 (12)	-	-
Missing	-	-	3
Non-urgent or elective surgical procedures	**(n=24)**	**(n=25)**	**(n=9)**
Much more	1 (4)	-	-
Somewhat more	-	1 (4)	2
About the same	1 (4)	2 (8)	4
Somewhat less	3 (13)	6 (24)	1
Much less	18 (75)	16 (64)	1
Do not know	1 (4)	-	-
Missing	-	-	1

[1]Denominators vary due to services provided at the facilities. *Includes directors of four HC IV facilities.

Frequency and reported reasons for service disruption

Over 70% of all South African facilities (72%; 31/43) reported at least one disruption to essential health services. Of these 31 facilities which reported any disruption, 30 (97%) indicated that it was IPC related. In Uganda, 96% (44/46) reported at least one disruption, and for 39 (89%) of these facilities, the disruption was IPC related. A total of 35 facilities (88%) in Côte d'Ivoire reported experiencing at least one service disruption, all of which were IPC-related. The reasons for the service disruptions are presented in Table 4, with the IPC-related reasons indicated with an *.

Table 4: Frequency of reasons for service disruptions: South Africa, Uganda, Côte d'Ivoire

	SA (N=31)	UG (N=44)	CDI (N=35)
	N (%)	N (%)	N (%)
Outbreaks of COVID-19 illness among facility patients/staff*	22 (71)	23 (52)	18 (51)
National/provincial/regional IPC directive(s)*[1]	19 (61)	34 (77)	31 (89)
National/provincial/regional directive(s) not related to IPC	18 (58)	25 (57)	24 (69)
Staff shortages due to COVID-19 illness among staff*	14 (45)	17 (39)	0 (0)

General supply chain disruptions	14 (45)	20 (46)	0 (0)
Implementation of physical distancing measures*	12 (39)	14 (32)	17 (49)
Conversion to a designated COVID-19 unit/center	8 (26)	29 (66)	3 (9)
Mandated travel restrictions/transport disruption	8 (26)	42 (96)	3 (9)
Additional time needed to implement IPC procedures*	8 (26)	10 (23)	24 (69)
Staff shortages due to re-deployment of facility personnel to provide COVID-19 care to patients within the same facility	5 (16)	3 (7)	0 (0)
Financial difficulties during lockdown	2 (6)	0 (0)	0 (0)
Inability to meet physical-distancing requirements*	3 (10)	5 (11)	2 (6)
Staff absences because of perceived IPC-related risks*	3 (10)	5 (11)	1 (3)
Reduced number of patients attending services	1 (3)	2 (5)	0 (0)
Breakdown of essential machinery and equipment, such as electricity, water	1 (3)	3 (7)	1 (3)
Staff absences due to demands for hazard pay*	1 (3)	4 (9)	0 (0)
Staff shortages due to demands for COVID-19 training*	1 (3)	2 (5)	0 (0)
Lack of adequate personal protective equipment (PPE)*	1 (3)	11 (25)	1 (3)
Shortages of IPC-related equipment or supplies (non-PPE)[2]*	1 (3)	2 (5)	0 (0)
Other	1 (3)	27 (61)	3 (9)

[1]Directives on preventing or controlling the spread of the SARS-CoV2 virus from the central or regional/provincial health authorities. These included social distancing measures, suspension of services, limiting of patients, facility disinfection procedures. [2]e.g., facility disinfection, equipment sterilization, etc. *IPC-related reason

The most frequently cited reasons for service disruption in the South African facilities were the IPC-related reasons of COVID-19 illness among facility patients/staff (71%), followed by IPC-related directive(s) (61%). In Uganda, mandated travel restriction was the most frequently reported disruption (96%), with the IPC directive(s) (77%) as the most frequently cited IPC-related reason for service disruption. Disruption by conversion to a COVID-19 center or unit was reported in two-thirds of facilities (n=29). Notably, 25% of facilities reported shortages of PPE as a reason for disruption. Like Uganda, IPC directive(s) (89%) was the most cited reason for disruption in Côte d'Ivoire. Other frequently stated reasons were directives not related to IPC (69%) and time needed to implement IPC procedures such as facility disinfection and equipment sterilization (69%). Across all three countries, directives (IPC and non-IPC related) were frequently reported reasons for service disruption.

Type, severity, and duration of disruption

We found high agreement (>90%) for the facility director and the IPC-Focal Point on nearly all the reported service disruptions; facility closure, ward closure, service suspended, service hours reduced, staff reduction, and patient volume limited. The agreement for service scope reduced was 88%. Subsequently, we proceeded with presenting the facility director responses.

Table 5 presents the type, severity, and duration of disruptions across the three countries. Over 80% (n=25) of South African facilities reporting service disruptions suspended services, followed by limiting patient volume, 58% (n=18). Six facilities had ward closures; this service disruption had the longest median duration of nearly 46 weeks. Service suspension had the second longest median duration of 28 weeks. The severity of disruptions tended to be moderate, as for most facilities 25-49% of each service was affected.

In Uganda, limiting patient volume was the most frequent disruption, reported by 43 of the 44 facilities. This was followed by reductions in service staff, 57% (n=25), and services suspended, 55% (n=24). Though only four facilities reported ward closures, the median length of time of this disruption was 20 weeks. Almost half of the facilities reported severe reductions in service scope (affecting ≥ 50% of patients). Disruption from limiting patient volume and staff reductions tended to be moderate (25-49%).

Similar to in Uganda, limiting patient volume was the most frequent disruption in Côte d'Ivoire, reported by nearly all facilities, 34/35. Service staff reduced was reported by 34% of facilities (n=12). Duration of disruption was longest for service scope reduction, with a median time of 36 weeks. The severity of the disruptions overall was reported minimal to moderate.

Table 5: Type, severity, and duration of essential health services disruption

	South Africa			Uganda			Côte d'Ivoire		
Service disruption *(definitions in italics)*	**Number (%) reporting disruption (n=31)**	**Severity of disruption (percentage of service(s) affected, %)**	**Weeks of disruption (Median, Q1, Q3-)**	**Number (%) reporting disruption (n=44)**	**Severity of disruption (percentage of service(s) affected, %)[#]**	**Weeks of disruption (Median, Q1, Q3)**	**Number (%) reporting disruption (n=35)**	**Severity of disruption (percentage of service(s) affected, %)**	**Weeks of disruption (Median, Q1, Q3)**
Service suspension *"Were any services stopped or no longer offered since February 2020 due to COVID-19?"*	25 (81)		28.1 (13,73.1)	24 (55)		16.9 (8.2, 20.1)	1 (3)		2.9 (2.9, 2.9)
Limiting patient volume *"Did your facility elect to limit patient volumes receiving services since February 2020 due to COVID-19?"*	18 (58)	≥75%: 0 50-74%: 2 (11%) 25-49%: 10 (56%) 5-24%: 4 (22%) 0-4%: 2 (0%)	15.4 (12.1, 44.6)	43 (98)	≥75%: 2 (5%) 50-74%: 10 (23%) 25-49%: 16 (37%) 5-24%: 14 (33%) 0-4%: 1 (2%)	16.4 (11.6, 17.4)	34 (97)	≥75%: 1 (3%) 50-74%: 5 (14%) 25-49%: 12 (34%) 5-24%: 12 (34%) 0-4%: 5 (14%)	19.4 (13.0, 31.6)
Service scope reduced *"Was the breadth of a healthcare service narrowed since February 2020 due to COVID-19?"*	13 (42)	≥75%: 1 (8%) 50-74%: 1 (8%) 25-49%: 8 (62%) 5-24%: 3 (23%)	15.7 (4.4, 36.7)	16 (36)	≥75%: 1 (6%) 50-74%: 7 (41%) 25-49%: 7 (41%) 5-24%: 2 (12%)	16.2 (9.6, 20.1)	3 (9)	≥75%: 0 50-74%: 1 (%) 25-49%: 1 (%) 5-24%: 1 (%) 0-4%: 0	35.8 (25.3, 48.7)
Service staff reduced *"Were the number of staff providing a healthcare service reduced since February 2020 due to COVID-19?"*	12 (39)	≥75%: 2 (16%) 50-74%: 1 (8%) 25-49%: 8 (67%) 5-24%: 1 (8%)	19.4 (3.2, 55.8)	25 (57)	≥75%: 2 (8%) 50-74%: 3 (11%) 25-49%: 8 (31%) 5-24%: 7 (27%) 0-4%: 6 (23%)	16.0 (10.6, 17.4)	12 (34)	≥75%: 0 50-74%: 2 (15%) 25-49%: 2 (15%) 5-24%: 6 (46%) 0-4%: 3 (23%)	16.1 (8.2, 27.6)
Service hours reduced *"Were the hours that a healthcare service is delivered reduced since February 2020 due to COVID-19?"*	8 (26)	≥75%: 0 (0%) 50-74%: 0 (0%) 25-49%: 5 (%) 5-24%: 2 (%) 0-4%: 1 (%)	14.0 (3.2, 30.2)	19 (43)	≥75%: 2 (10%) 50-74%: 4 (20%) 25-49%: 5 (25%) 5-24%: 6 (30%) 0-4%: 3 (15%)	14.6 (10.6, 17.4)	7 (20)	≥75%: 1 (%) 50-74%: 1 (%) 25-49%: 0 5-24%: 6 (%) 0-4%: 0	24.7 (5.3, 48.7)
Inpatient ward closures *"Were any inpatient wards ever closed since February 2020 due to COVID-19?*	6[1] (21)		45.9 (6.3, 79.1)	4[2] (12)		20.4 (12.6, 51.4)	2[3] (13)		2.9 (2.3, 3.4)
Facility closure *"Was the facility ever closed since February 2020 due to COVID-19?"*	3 (10)		0 (0, 1)	1 (2)		99.3 (99.3, 99.3)	0 (0)		

[1]n=28, [2]n=33, [3]n=16, [#]Data not available.

Types of disruption by essential services

Tables 6, 7 and 8 present the frequencies of essential services disruption among facilities by type of disruption, for South Africa, Uganda, and Côte d'Ivoire, respectively.

Outpatient services

All outpatient services in South Africa experienced all types of disruption (service suspended, service scope reduced, service staff reduced, service hours reduced, limiting patient volumes). ANC and PNC, and non-communicable disease services were reported to have the most disruptions, particularly service suspension, and limiting patient volumes. Emergency care/casualty, acute care and mental health services were reported to have less disruptions. Uganda reported all outpatient service points experiencing at least three types of disruption. ANC and PNC services, again, were most affected with disruption across all five types, ranging from 20% of PNC services having reduced scope to 91% of ANC services limiting patient volumes. Limiting patient volume was the most frequently reported disruption across all service delivery points ranging from 56% to 91% of facility services, except for other outpatient services. Except for limiting patient volumes, Côte d'Ivoire reported relatively minimal service disruptions. However, limiting patient volumes ranged from 33% to 84% of outpatient services. ANC and HIV prevention, diagnosis and treatment were the more affected services, with the higher proportions of disruptions, across at least four types of disruptions.

Inpatient services

Fewer inpatient services were reported disrupted in South Africa, though over 60% of facilities providing non-emergency surgery had these services disrupted. Reduction in service staff and limiting patient volumes affected all inpatient services, with 46% of maternity wards disrupted by reduced staff. There were few ward closures, although 13% of "other" inpatient services were affected. In Uganda, fewer inpatient compared to outpatient services were disrupted, though limiting patient volumes disrupted over 60% of emergency surgical services and medical wards. Inpatient services in Côte d'Ivoire were affected most by limiting patient volumes, with 80% of medical wards (n=12), and 60% of maternity wards (n=9) impacted by this type of disruption.

Community outreach services

In South Africa, relatively few community outreach services were disrupted, though "other" community outreach services were affected by service suspension (60%) and by staff reductions (67%). In Uganda, limiting patient volumes affected all the community outreach services, ranging from 25% to 43% of service disruptions, while about 20% of immunization, TB and HIV contact tracing services had services suspended. Community outreach services in Côte d'Ivoire were minimally disrupted, though 25-30% of facilities providing immunization, HIV and TB contact tracing/treatment services were affected by limiting patient volumes.

Table 6: Frequency of essential services disruption among facilities by type of disruption, South Africa

Services	Type of disruption					
	Service suspended	Service scope reduced	Service staff reduced	Service hours reduced	Limiting patient volumes	Ward closure(s)
	N (%)	N (%)	N (%)	N (%)	N (%)	N
Outpatient services						
1. Antenatal Care (n=39)	17 (44)	9 (23)	11 (28)	8 (21)	13 (33)	N/A
2. Postnatal Care (n=34)	11 (32)	7 (21)	11 (32)	4 (12)	13 (38)	N/A
3. Family Planning and Contraception (n=40)	3 (8)	4 (10)	9 (23)	3 (8)	7 (18)	N/A
4. Routine Immunization (n=33)	6 (18)	4 (12)	7 (21.2)	4 (12)	8 (24)	N/A
5. Under 5 Clinic (n=34)	4 (12)	2 (5.9)	9 (27)	3 (9)	4 (12)	N/A
6. HIV prevention, diagnosis, and treatment (n=43)	10 (23)	3 (7)	11 (26)	3 (7)	11 (26)	N/A
7. TB case detection and treatment (n=43)	4 (9)	5 (12)	11 (26)	3 (7)	9 (21)	N/A
8. Cancer screening, diagnosis, and treatment (n=37)	4 (11)	2 (5)	9 (24)	2 (5)	7 (19)	N/A
9. Non-communicable disease services (n=42)	17 (41)	10 (24)	10 (24)	4 (10)	9 (21)	N/A
10. Acute care services (n=42)	3 (7)	3 (7)	11 (26)	3 (7)	7 (17)	N/A
11. Mental health services (n=39)	2 (5)	2 (5)	8 (20.5)	2 (5)	3 (8)	N/A
12. Rehabilitation services (n=37)	4 (11)	5 (14)	6 (16)	3 (8)	6 (16)	N/A
13. 24-hour Emergency care/casualty services (n=32)	1 (3)	1 (3)	7 (22)	0 (0)	4 (13)	N/A
14. Other outpatient service (n=25)	4 (16)	1 (4)	6 (24)	3 (12)	4 (16)	N/A
15. Nutrition (n=41)	3 (7)	3 (7)	8 (20)	3 (7)	7 (17)	N/A
Inpatient services						
16. Maternity ward (n=24)	1 (4)	0 (0)	5 (46)	0 (0)	1 (6)	2 (8)
17. Medical Wards (n=24)	0 (0)	0 (0)	5 (21)	0 (0)	3 (13)	2 (8)
18. Mental Health Wards (n=19)	0 (0)	0 (0)	5 (26)	0 (0)	3 (16)	0 (0)
19. Emergency/non-elective surgeries (n=22)	1 (5)	0 (0)	3 (14)	0 (0)	2 (9)	1 (5)
20. Non-emergency/elective surgical services (n=23)	14 (61)	6 (26)	4 (17)	1 (4)	4 (17)	0 (0)
21. Other inpatient services (n=24)	2 (8)	2 (17)	4 (36)	0 (0)	5 (29)	3 (13)
Community outreach services						
22. Maternal and Child Health (n=17)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	N/A
23. Immunization (n=19)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	N/A
24. TB contact tracing/treatment (n=27)	1 (4)	2 (7)	1 (4)	1 (4)	2 (7)	N/A
25. HIV contact tracing/treatment (n=27)	2 (7)	2 (7)	2 (7)	1 (4)	2 (7)	N/A
26. Community based mobile clinics (n=13)	2 (15)	0 (0)	1 (8)	0 (0)	0 (0)	N/A
27. Other community/outreach services (n=15)	9 (60)	1 (7)	3 (67)	1 (7)	4 (27)	N/A

Table 7: Frequency of essential services disruption among facilities by type of disruption, Uganda

Services	Type of disruption					
	Service suspended	Service scope reduced	Service staff reduced	Service hours reduced	Limiting patient volumes	Ward closure(s)
	N (%)	N (%)	N (%)	N (%)	N (%)	N
Outpatient services						
1. Antenatal Care (n=43)	17 (40)	14 (33)	19 (44)	16 (37)	39 (91)	N/A
2. Postnatal Care (n=41)	16 (39)	8 (20)	15 (37)	13 (32)	35 (85)	N/A
3. Family Planning and Contraception (n=41)	8 (20)	4 (10)	11 (27)	10 (24)	35 (85)	N/A
4. Routine Immunization (n=45)	14 (31)	6 (13)	13 (29)	16 (36)	39 (87)	N/A
5. Under 5 Clinic (n=35)	3 (9)	6 (17)	6 (17)	0 (0)	28 (80)	N/A
6. HIV prevention, diagnosis, and treatment (n=45)	11 (24)	6 (13)	20 (44)	12 (27)	37 (82)	N/A
7. TB case detection and treatment (n=45)	2 (4)	4 (9)	13 (29)	10 (22)	33 (73)	N/A
8. Cancer screening, diagnosis, and treatment (n=40)	1 (3)	0 (0)	7 (18)	8 (20)	28 (70)	N/A
9. Non-communicable disease services (n=45)	6 (13)	8 (18)	11 (24)	10 (22)	35 (78)	N/A
10. Acute care services (n=40)	0 (0)	1 (3)	8 (20)	7 (18)	28 (70)	N/A
11. Mental health services (n=37)	1 (3)	1 (3)	7 (19)	7 (19)	22 (60)	N/A
12. Rehabilitation services (n=20)	1 (5)	1 (5)	4 (20)	2 (10)	14 (70)	N/A
13. 24-hour Emergency care/casualty services (n=36)	0 (0)	0 (0)	4 (11)	2 (6)	21 (60)	N/A
14. Other outpatient service (n=24)	3 (13)	1 (4)	3 (13)	2 (8)	4 (17)	N/A
15. Nutrition (n=36)	1 (3)	1 (3)	7 (19)	4 (11)	20 (56)	N/A
Inpatient services						
16. Maternity ward (n=45)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)
17. Medical Wards (n=33)	0 (0)	1 (3)	6 (18)	1 (3)	20 (61)	1 (3)
18. Mental Health Wards (n=10)	0 (0)	1 (10)	3 (30)	0 (0)	2 (20)	1 (10)
19. Emergency/non-elective surgeries (n=30)	1 (3)	0 (0)	3 (10)	1 (3)	19 (63)	0 (0)
20. Non-emergency/elective surgical services (n=30)	5 (17)	4 (13)	4 (13)	1 (3)	18 (16)	0 (0)
21. Other inpatient services (n=4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Community outreach services						
22. Maternal and Child Health (n=36)	4 (11)	1 (3)	1 (3)	2 (6)	9 (25)	N/A
23. Immunization (n=42)	9 (21)	1 (2)	4 (10)	6 (14)	15 (36)	N/A
24. TB contact tracing/treatment (n=40)	8 (20)	4 (10)	4 (10)	7 (18)	17 (43)	N/A
25. HIV contact tracing/treatment (n=43)	8 (19)	4 (9)	4 (9)	7 (16)	17 (40)	N/A
26. Community based mobile clinics (n=5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	N/A
27. Other community/outreach services (n=5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	N/A

Table 8: Frequency of essential services disruption among facilities by type of disruption, Côte d'Ivoire

Services	Type of disruption					
	Service suspended	Service scope reduced	Service staff reduced	Service hours reduced	Limiting patient volumes	Ward closures
	N (%)	N (%)	N (%)	N (%)	N (%)	N
Outpatient services						
1. Antenatal Care (n=37)	1 (3)	3 (8)	10 (27)	6 (16)	31 (84)	N/A
2. Postnatal Care (n=37)	1 (3)	0 (0)	4 (11)	3 (8)	23 (62)	N/A
3. Family Planning and Contraception (n=33)	1 (3)	0 (0)	3 (9)	3 (9)	18 (55)	N/A
4. Routine Immunization (n=34)	1 (3)	1 (3)	4 (12)	4 (12)	23 (68)	N/A
5. Under 5 Clinic (n=33)	1 (3)	0 (0)	3 (9)	3 (9)	17 (52)	N/A
6. HIV prevention, diagnosis, and treatment (n=39)	0 (0)	2 (5)	11 (28)	6 (15)	31 (80)	N/A
7. TB case detection and treatment (n=25)	0 (0)	0 (0)	4 (16)	4 (16)	15 (60)	N/A
8. Cancer screening, diagnosis, and treatment (n=12)	0 (0)	0 (0)	1 (8)	1 (8)	4 (33)	N/A
9. Non-communicable disease services (n=20)	0 (0)	0 (0)	2 (10)	2 (10)	11 (55)	N/A
10. Acute care services (n=12)	1 (8)	0 (0)	1 (8)	2 (17)	4 (33)	N/A
11. Mental health services (n=4)	0 (0)	0 (0)	0 (0)	1 (25)	3 (75)	N/A
12. Rehabilitation services (n=6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	N/A
13. 24-hour Emergency care/casualty services (n=14)	1 (7)	0 (0)	2 (14)	2 (14)	3 (21)	N/A
14. Other outpatient service (n=19)	0 (0)	1 (5)	1 (5)	3 (16)	8 (42)	N/A
15. Nutrition (n=29)	0 (0)	0 (0)	2 (7)	3 (10)	10 (35)	N/A
Inpatient services						
16. Maternity ward (n=15)	1 (7)	2 (13)	3 (20)	3 (20)	9 (60)	0 (0)
17. Medical Wards (n=15)	0 (0)	1 (7)	5 (33)	3 (20)	12 (80)	2 (13)
18. Mental Health Wards (n=4)	0 (0)	0 (0)	0 (0)	0 (0)	3 (75)	0 (0)
19. Emergency/non-elective surgeries (n=9)	0 (0)	0 (0)	0 (0)	1 (11)	2 (22)	0 (0)
20. Non-emergency/elective surgical services (n=9)	0 (0)	0 (0)	0 (0)	1 (11)	2 (22)	0 (0)
21. Other inpatient services (n=0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Community outreach services						
22. Maternal and Child Health (n=6)	0 (0)	0 (0)	1 (17)	0 (0)	2 (33)	N/A
23. Immunization (n=17)	0 (0)	0 (0)	1 (6)	0 (0)	5 (29)	N/A
24. TB contact tracing/treatment (n=12)	0 (0)	0 (0)	1 (8)	1 (8)	3 (25)	N/A
25. HIV contact tracing/treatment (n=27)	0 (0)	0 (0)	2 (7)	2 (7)	8 (30)	N/A
26. Community based mobile clinics (n=3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (33)	N/A
27. Other community/outreach services (n=6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	N/A

Detailed reasons for IPC-related disruptions

The facility IPC Focal Points were asked more detailed questions regarding the reasons for IPC-related disruptions, including relevant practices/procedures prior to the disruption, and strategies taken to mitigate the effect of the disruption.

Service disrupted as per national/regional/district MOH IPC-related directives

IPC-FPs were asked about service disruption due to MOH IPC-related directives. In South Africa, IPC-FPs for 16/42 (38%) facilities responded in the affirmative to this question, with a median disruption time of 28.3 weeks (IQR: 9.3, 61.6). Eight facilities (50%) implemented the directives within a week, 6 (38%) within 24 hours, and 2 (13%) took more than a week for implementation. IPC-FPs subsequently were asked if there were any actions taken to mitigate the effect of this service, and if so, what actions. One facility did not take mitigating actions; the actions for the 15 facilities reporting mitigation are summarized in Table 9.

In Uganda, 16/46 (38%) IPC-FPs reported that services had been disrupted by IPC-related directives. This disruption was reported to have a median time of 17.4 weeks (IQR: 11.6, 49.6). The directives were implemented within 24 hours in 14 facilities (88%); while this was achieved within a week in one facility and another facility took more than a week.

Côte d'Ivoire IPC-FPs reported that services had been disrupted by IPC-related directives in 3/35 facilities (9%). One facility implemented the directives within 24 hours, one within a week, and the other facility took more than a week.

Table 9: Actions taken to mitigate facility service disruptions due to MOH IPC-related directives

Actions taken to mitigate service disruption	SA (N=15)	UG (N=8)	CDI (n=3)
	N (%)	N (%)	N (%)
Priority given to serving high-risk patients	11 (73)	5 (63)	1
Extended multi-month prescriptions, e.g., for HIV, NCD	9 (60)	6 (75)	2
Supported self-care initiatives, where appropriate	9 (60)	1 (13)	0
Provided home-based care for certain patients	7 (47)	5 (63)	0
Redirected patients to other health care facilities	6 (40)	5 (63)	3
Redirected patients to community-located sites	5 (33)	3 (38)	1
Provide all care in a single visit for multiple morbidities	0 (0)	4 (50)	1
Cared for patients via telephone or internet connection	0 (0)	4 (50)	1
Other	3 (20)	0 (0)	0

In South Africa, the most cited action mitigating IPC-related directives was prioritizing high-risk patients, 73%. Other commonly cited actions were extending multi-month prescriptions and supporting self-care initiatives, both 60%. The Uganda facilities cited a number of mitigating actions including, extending multi-month prescriptions, prioritizing high-risk patients, providing home-based care and redirecting patients to other health care facilities.

Health personnel shortages due to COVID-19 illness or fear of illness

In facilities where health personnel shortages due to COVID-19 illness or fear of illness was indicated as a reason for service disruption, IPC-FPs were asked to provide further detail. Specifically, they were asked how, prior to service disruption, health care workers (HCWs) could have been exposed to COVID-19 while working at the facility (Table 10); among which staff cadres experienced shortages due to COVID-19 illness or fear of illness at the time of disruption (Table 12); and whether staff deployed from their usual units to other units in the facility to keep services running as normal, and if so, why. Also, did the facility develop plans to prevent or reduce staff absences due to COVID-19 illness, exposure, or fear of exposure (Table 13); and were staff deployed from their usual units to *other* facilities to keep services running as normal.

In South Africa, 17/42 facilities (40%) reported service disruption because of health personnel shortages due to COVID-19 illness or fear of illness, with a median disruption time of 13.1 weeks (IQR: 3.0, 22.9). Nearly 60% (n=27/46) of the Uganda facilities reported this reason for service disruption. The median time for this disruption was 16.4 weeks (IQR: 9.7, 17.4). In Côte d'Ivoire, 2/35 facilities reported this source of disruption, with the median disruption time of 27.6 weeks (IQR: 16.0, 39.3).

The ways in which HCWs reported they could have been exposed to COVID-19 at work are presented in Table 10.

Table 10: Ways in which HCWs could have been exposed to COVID-19 while working at the facility, (prior to service disruption)

HCW exposure to COVID-19	SA (N=17)	UG (N=27)	CDI (n=2)
	N (%)	N (%)	N (%)
Unable to social distance from other staff	12 (71)	19 (70)	1
Lack of or insufficient PPE	10 (59)	27 (100)	1
Congregating in settings with other staff	9 (53)	12 (44)	0
Improper use of PPE	7 (41)	17 (63)	0
Lack of or insufficient cleaning and disinfecting supplies	7 (41)	18 (67)	0
Lack of or insufficient supplies for handwashing	6 (35)	8 (30)	0
Unable to social distance from patients (no space)	6 (35)	18 (67)	1
Poor ventilation	5 (29)	8 (30)	0
Lack of COVID-19 training/orientation	4 (24)	11 (41)	0
Lack of or insufficient training in IPC	0 (0)	10 (37)	0
Lack of guidance about which PPE to use	4 (24)	7 (26)	0
Inadequate training in donning/doffing PPE	2 (12)	8 (30)	0
Lack of or unclear IPC guidance	2 (12)	7 (26)	0
Other	1 (6)	3 (11)	0

For South Africa, inability to social distance from other staff was the most cited way HCWs could have been exposed (71%); lack of or insufficient PPE and congregating in settings with other staff, were frequently cited; 59% and 53%, respectively. The Ugandan respondents most frequently cited lack of PPE (all facilities), followed by inability to social distance from staff (70%),

lack of cleaning supplies and inability to social distance from patients (67%). Respondents from 17 facilities (63%) cited improper use of PPE.

Table 11: Staff cadre shortages due to COVID-19 illness or fear of illness (N=17)

	SA (N=17)	UG (N=27)	CDI (N=2)
	N (%)	N (%)	N (%)
Professional nursing staff	16 (94)	26 (96)	2
Office staff (administrators/clerks)	16 (94)	12 (44)	1
Cleaners	15 (88)	13 (48)	0
Auxiliary nursing staff	14 (82)	17 (63)	0
Support staff (Cooks/gardeners/security guards)	11 (65)	12 (44)	0
Medical staff	10 (59)	20 (74)	1
Lay cadres	9 (53)	10 (37)	0

In South Africa, professional nursing and office staff were most affected with 94% of facilities reporting these staff shortages due to COVID-19 illness and fear. Overall, more than half of the facilities reported this staff shortage reason as disrupting services. Staff were deployed from their usual units to other facility units to keep services running as normal in 14 (82%) facilities.

In Uganda, the professional nursing staff, medical staff, and auxiliary nursing staff were most affected by staff shortage for this reason. In 17 facilities (63%), staff were deployed from their usual units to other facility unit to keep services running.

The responses to whether the facility had developed plans to prevent or reduce staff absences due to COVID-19 illness, exposure, or fear of exposure, resulting from health personnel shortages, are summarized in Table 12.

Table 12: Planned actions to prevent/reduce staff absences due to COVID-19 illness, exposure or fear of exposure

	SA (N=17)	Uganda (N=27)	CDI (N=2)
	N (%)	N (%)	N (%)
Screen staff daily for fever, symptoms, and/or exposures	17 (100)	26 (96)	0
Quarantine for exposed staff	16 (94)	24 (89)	0
Isolation and return to work requirements for infected staff	16 (94)	26 (96)	1
Requested sufficient sanitizing materials	15 (88)	19 (70)	0
Requested sufficient PPE	13 (77)	24 (89)	0
Provided training on COVID-19	12 (71)	22 (82)	0
Provide training on IPC/PPE use	12 (71)	23 (85)	0
Provided guidance/SOPs on IPC	11 (65)	21 (78)	0
Installed barriers in registration area	9 (53)	7 (26)	0
Reorganized/increase space, patient triage for social distancing	8 (47)	13 (48)	0

Repaired/improved water supply/obtained sufficient soap	5 (29)	8 (30)	1
Re-budgeted/redirected funds to purchase PPE and IPC supplies	3 (18)	11 (41)	0
Improved ventilation, i.e. installed fans	3 (18)	2 (7)	0
Instituted disciplinary guidelines for not following procedures	2 (12)	6 (22)	0
Other	0	0	1

In South Africa, all responding facilities developed plans for screening staff, and 94% had plans for both quarantining exposed staff, and isolation and return to work requirements for infected staff. Other common actions were requesting sufficient sanitizing materials (88%), PPE (77%), and the provision of training on COVID-19 (71%) and IPC/PPE use (71%). Similar to South Africa, Uganda's facilities plans' included daily staff screening, quarantine for those exposed, isolation and return to work requirements for infected staff and requesting sufficient PPE.

In Uganda, IPC-FP were asked if, during the time of the disruption, staff were deployed from their usual units to *other* facilities to keep services there running as normal. Four facilities (15%) deployed staff to other facilities, as there were insufficient staff there (2) or for other reasons (2). About a third (35%, 6/17) of SA facilities deployed staff from their usual units to other facilities. For five of these six facilities, staff were deployed because there were insufficient staff in the other facilities, while for one, it was for another (unspecified) reason.

Health personnel shortages due to COVID-19 illness or fear of illness – themes from participants' comments

In what ways did IPC, or limitations in IPC, play a role in health personnel shortages due to COVID-19? What were the main challenges?

In South Africa, respondents commented that these challenges included a number of health personnel all testing COVID-19 positive at the same time, having to quarantine for 14 days, including contacts. Also, confusion and panic among staff about COVID-19 and changes in the guidelines, which sometimes led to them seeking support from each other and not social distancing. There was a comment that the shortage of staff led to a lack of proper facility disinfection which led to continuous reinfection among staff members. Other comments were a lack of compliance with IPC principles by staff, and the incorrect use of PPE with subsequent wastage.

In Uganda, IPC-FPs commented that staff were fearful to come to work when there was no PPE. The lack of PPE made it difficult to practice IPC guidelines, leading to additional infections. Consumption of PPE was high, leading to shortages, and consequent infection with COVID-19, also as staff had difficulty social distancing. Other comments included incorrect use of PPE, and lack of training and lack of skill in donning and doffing.

Côte d'Ivoire respondents commented that the lack of PPE contributed to the risk of infection and the lack of ability to social distance from patients.

What IPC policies, practices, and resources were most helpful when addressing challenges related to health personnel shortages due to COVID-19?

The South African respondents commented that the training, guidelines, and SOPs were most helpful. For example, quarantine for infected health workers, social distancing, and focus on cleanliness and sanitizing, and proper handwashing. In addition, SOPs on the correct use of PPE, and the donning and doffing procedures. Support from the Provincial and National Departments of Health was also acknowledged as helpful.

Ugandan respondents frequently mentioned training as helpful in addressing these challenges. Also, the implementation of IPC/COVID-19 guidelines. Other comments about resources that were helpful were service integration, the recruitment of health worker volunteers, recalling staff from leave, working longer shifts, providing transport for health workers, psychological support for COVID-19 infected staff, and the availability and prioritization of PPE. In addition, having appointments for clients was considered helpful.

In Côte d'Ivoire, respondents commented that the distribution of tasks according to the availability of the staff and different cadres, i.e., a form of task shifting, was helpful, as was rotation of staff in different service delivery areas with their time-off.

What policies, practices, and resources would be helpful to avoid having health personnel shortages in the future? [Prompts: international or national guidelines; trainings; support from district health officials, MoH, implementing partners]

South African respondents commented that training (on IPC/COVID-19 guidelines) and support for staff and hiring more staff would be helpful in avoiding future health-related personnel shortages. Furthermore, implementation and adherence to guidelines, and more space, for example for consultation and waiting rooms. Additionally, more direct support from the Department of Health, at both provincial and national level, and management, including the provision of incentives. They suggested that support should include clarity on the implementation of the guidelines or regulations, rather than just issuing of "orders", more "visual support".

In Uganda, there were many comments on having more resources/budget, more staffing and incentives/risk compensation for staff, and more staff training and mentoring. There were also comments on private and government facilities being equally resourced, and on community sensitization, handwashing, and waste management.

In Côte d'Ivoire, having sufficient staff trained in all topics was stated to be helpful, as was having good infection prevention organization within the facility.

Lack of PPE

In examining the lack of PPE as contributing to service disruption, IPC-FPs were asked about PPE availability immediately prior to the disruption, whether the facility had taken an inventory of

PPE, whether the facility used calculators to estimate the use of PPE, how PPE was ordered, who were the main suppliers, and what strategies were used to conserve PPE.

For South Africa, only one facility indicated a lack of PPE as contributing to service disruption. The median overall time that this contributed to service disruption was 34.9 weeks (IQR: 34.9, 34.9). The lack of PPE in this facility included gloves, surgical/medical masks, gowns, respirator masks, goggles, boots, and face shields. The South African facility did an inventory of PPE monthly, did not use a calculator to estimate "burn" rates, and ordered through the National/Central Stores Organization and regional authority.

In Uganda, 11 facilities (24%), indicated that there was a lack of PPE immediately prior to the disruption. Gowns were the PPE more commonly reported as lacking (7 of the 11), and there was also lack of availability of boots and face shields (6 facilities) (Table 13). Four facilities took inventories monthly, three weekly or biweekly, one quarterly, and another annually. One IPC-FP indicated "other" in answer to this question, and one did not know. Four facilities (36%) did not use a calculator to estimate "burn" rates, IPC-FPs for the other facilities (7) indicated that they used other ways of estimating "burn" rates.

In Côte d'Ivoire, there was no additional information on the shortage of PPE.

Table 13: Availability of PPE prior to service disruption: Not available

	Uganda (n=11)
	N (%)
Gloves	0 (0)
Surgical/medical mask	1 (9)
Gown	7 (64)
Respirator mask (i.e. N95)	4 (36)
Goggles	5 (45)
Boots	6 (55)
Face shield	6 (55)

Most of the Ugandan facilities 82% (n=9) ordered the PPE through the National/Central Stores organization, one facility placed orders to a faith-based organization, and one had an "other" ordering process.

The strategies used to conserve PPE by the South Africa facility was extending the use of surgical/medical masks, gowns, and faces shields/googles. Strategies to conserve PPE in Uganda is presented in Table 14.

Table 14: Strategies to conserve PPE

	Uganda (n=11)
Extended use of surgical/medical masks*	10 (91)
Extended use of respiratory masks	7 (64)
Extended use of gowns	4 (36)
Reuse of gowns†	6 (55)
Reuse of surgical/medical masks	9 (82)
Reuse of respiratory masks	4 (36)

Reuse of face shields/googles	4 (36)
Extended use of face shields/googles	4 (36)

*Extended use = wearing same PPE for multiple patients without removing respirator between patients. †Reuse = using same PPE for multiple patients but removing it after each patient

Ten of the 11 Uganda facilities extended the use of surgical/medical masks; nine reused them, and seven extended the use of respiratory masks. Six facilities reused gowns.

One South Africa facility reported shortages of IPC-related equipment or supplies other than PPE leading to service disruption, with a median time of disruption for this reason of 4.4 weeks. In Uganda, two facilities reported shortages of IPC-related equipment or supplies other than PPE, with a median disruption time of 11.1 weeks (IQR: 7.7, 47.0). In all instances, the shortages were water, bleach, *N*-agent equivalents (e.g. quaternary ammonia, dodecylbenzenesulfonic acid/L-Lactic acid, sodium hypochlorite, hydrogen peroxide/peroxyacetic acid, waste disposal supplies, and brushes/scrubbers. No shortages of non-PPE IPC-related equipment or supplies were reported for Côte d'Ivoire.

Lack of PPE – themes from participants' comments

What were the main challenges to having adequate PPE during COVID-19?

IPC-FPs in South Africa identified the main challenge to having adequate PPE as being a general shortage, due to high demand and cost. Uganda IPC-FPs identified challenges of high consumption, limited supplies (masks and gloves particularly), high cost and delays in supply. They also mentioned supply chain disruption and the "push" supply system where the National Medical Stores would deliver at their convenience.

What policies, practices, and resources were helpful to address the lack of PPE?

South African respondents commented that the national COVID-19 guidelines were helpful in addressing the lack of PPE. Uganda respondents stated that the extended use and re-use of PPE was helpful, as well as selective and restrictive use, and the requests from donors and implementing partners, and receipt of donations.

What would be helpful to avoid lacking PPE in the future? [Prompts: international or national guidelines; trainings; support from district health officials, MoH, implementing partners]

South African respondents commented that more effective consequences for staff non-compliance on how to use PPE (appropriate use/avoiding wastage), would be helpful, and strategies to retain staff. Ugandan respondents indicated that the MOH should strongly implement IPC policies in the facilities. Also, adequate planning and procurement of PPE, including increasing staffing and revising the supply chain and local manufacturing of PPE.

Shortages of IPC related equipment or supplies other than PPE (e.g. sterilization equipment, disinfectants, water, waste disposal, barriers)

What were the main challenges to having adequate IPC supplies and equipment (other than PPE) and handwashing supplies?

Neither the South African nor Côte d'Ivoire respondents provided comments on these challenges. Ugandan respondents commented that there were just not enough supplies; there was supply chain disruption and delayed supplies by the National Medical Stores. This was coupled with excess consumption.

What policies, practices, and resources were helpful to address the lack of availability of IPC supplies and equipment (other than PPE) and handwashing supplies?

The South African respondents replied that daily meetings held to check supplies were helpful, as were staff in-service trainings on the proper handling of equipment. Ugandan respondents commented that the National Medical Stores increasing its supplies, the extended use of equipment and supplies and timely ordering was helpful, as was requisition from Implementing Partners. Another comment was about the use of results-based-financing funds to procure the equipment and supplies.

Inability to identify and isolate patients for COVID-19

IPC-FPs who reported the inability to identify and isolate patients with COVID-19 as a reason for service disruption were asked additional questions including whether the facility screened for COVID-19 prior to service disruption, and if so, how it was done; if patients were not screened, what were the reasons; were patients with suspected COVID-19 triaged and if yes, how were they triaged, and if no, what were the reasons; were patients with suspected COVID-19 tested at the facility, and if not, why; and what actions were taken for patients that tested COVID-19 positive.

In South Africa, the three facilities that reported disruption due to this reason screened patients for COVID-19. The median time taken for this disruption was 81.3 weeks (IQR: 4.4, 101.3). All three used temperature checks and a screening questionnaire. Two facilities triaged patients with suspected COVID-19, both through placing them in a separate room, one by placing them in separate ward also, and one by referring them to another facility. The single facility that did not triage gave "other" reason for not doing so.

Actions taken by these three facilities for patients who tested positive for COVID-19 were placement in an isolation ward by two facilities, referral to another facility by one facility, recommendation for home isolation by two facilities, and referral to state-run isolation by two facilities.

In Uganda, IPC-FPs in 16 facilities reported disruption due to this reason, with a median disruption time of 15.9 weeks (IQR: 14.3, 17.9). All the facilities screened patients for COVID-19, with all using temperature checks, and eight also using a screening questionnaire, and one using other screenings.

In Côte d'Ivoire, two facilities reported disruption due to an inability to identify and isolate patients for COVID-19, both of which screened patients.

All 16 Ugandan facilities triaged patients with suspected COVID-19. About 56% (n=9), placed patients in a separate room, 6 (38%) in a separate ward, and 7 (44%) referred then to another facility. Actions taken for patients testing COVID-19 positive were referral to another facility 69% (n=11), placement in isolation ward, 56% (n=9), recommended home isolation 56% (n=9), and referral to government-run isolation centers, 25% (n=4).

There was no information on the triaging of patients in the Côte d'Ivoire facilities.

Inability to identify and isolate patients for COVID-19 – themes from participants' comments

What were the main challenges to screening, triaging, and isolating patients for COVID-19?

South African respondents commented that the daily routine of checking and isolating those who tested positive was challenging. Other challenges were the shortage of staff as no additional personnel were allocated for the testing; they had to improvise, and that some patients hid or suppressed their symptoms, while others feigned theirs to be tested or attended to.

Comments from Ugandan respondents were on insufficient space for isolation and social distancing, not enough staff (and limited expertise/knowledge on managing COVID-19) and inadequate PPE, testing equipment and supplies. There was a comment that the people performing the screening were not facility staff, so the staff had inadequate knowledge of the situation. Respondents also commented on patients not complying with isolation and other recommended actions.

Côte d'Ivoire respondents similarly commented that there was insufficient space for isolation, lack of test kits and non-compliant patients.

What policies, practices, and resources helped to address challenges related to screening, triage, and isolation of patients for COVID-19?

South African IPC-FPs responded that the COVID-19 and IPC policies, including the memorandum from the Department of Health were helpful. Additionally, mandatory screening of all patients entering the facility. In Uganda, training, mentorship and workshops, and the creation of a COVID-19 unit to lead the response was helpful. Additionally, guidelines, and the development of local guidelines. Other comments were the development/creation of more space (conversion of a mental health ward into a COVID-19 unit), reorganization of systems, sensitization of patients on arrival for easier organization, having more staff triage patients, improved reporting systems, and more equipment, for example, for temperature readings, and more PPE, as well as additional funds to motivate health workers.

What policies, practices, and resources would be helpful to avoid challenges related to screening, triage, and isolation or patients for COVID-19 in the future? [Prompts: international or national guidelines; trainings; support from district health officials, MoH, implementing partners]

South African respondents commented that IPC/COVID-19 protocols and guidelines, and training, and the handwashing policy would be helpful. As well the screening of staff and screening and triaging of patients. The provision of appropriate PPE for all staff, and the identification of separate entrances for staff donning and doffing PPE. Other comments were increasing the number of staff and providing staff a "danger" allowance. There were comments on the implementation of social distancing, having open spaces and reinstituting fumigation of facilities.

The provision of PPE, timely availability (avoidance of stock outs) and quality were most frequently commented by the Uganda respondents. IPC/COVID-19 training was also frequently mentioned, including on the donning and doffing of PPE. The availability of clear MOH guidelines was commented on as was vaccination of staff, the need to increase staff and to compensate staff for the risk of COVID-19 infection. Staff also needed to adhere to the IPC guidelines, and there was a suggestion for improvement of communication and cooperation between government and private facilities.

Côte d'Ivoire respondents suggested the availability of PPE and testing equipment, training, and support from district, MOH officials, and implementing partners, staff vaccinations, staff communication and patient awareness raising.

COVID-19 illness among health facility staff

In South Africa, 14 facilities reported COVID-19 illness in health facility staff as a reason for service disruption. The median disruption time for this reason was 5.1 weeks (IQR: 2.0, 21.9). Of these, immediately prior to the disruption, all reported screening staff for COVID-19, all 14 used a screening questionnaire. Prior to the service disruption, if staff were suspected of having COVID-19 illness, all 14 facilities tested staff, 12 (867%) facilities required home isolation, two (14%) isolated staff in the facility (e.g., nurses' home), and one (7%) took additional actions.

Seventeen facilities in Uganda reported COVID-19 illness among health facility staff as a reason for service disruption, with the median disruption time 12.4 weeks (IQR: 5.4, 17.4). Among these facilities 16 (94%) reported screening staff for COVID-19 illness, all of which used temperature checks, 10 (59%), a screening questionnaire in addition, and two (12%) other methods. In 16 facilities (94%), staff who tested positive were required to isolate at home, while in nine (53%), staff isolated in the facility.

In Côte d'Ivoire, three facilities reported COVID-19 illness among facility staff as a reason for service disruption, with the median disruption time of 7.6 weeks (IQR: 3.0, 11.7). Two facilities reported screening staff for COVID-19, both reported using "other" screening methods, and one using temperature checks. Action taken for staff suspected of having COVID-19 was home isolation by all three facilities. The reason that staff suspected of having COVID-19 were not tested was because of a lack of test kits (two facilities) and the need to prioritize the use of test kits in one facility. One facility also indicated "other" reasons.

IPC-FPs were asked what plans the facility developed to reduce the chance of future outbreaks because of service disruptions related to COVID-19 illness in patients and/or staff. The responses are presented in Table 15.

Table 15: Plans to reduce the risk of future outbreaks of COVID-19 among patients and/or staff in the facility

	SA (N=14)	UG (N=17)	CDI (N=3)
	N (%)	N (%)	N (%)
Implement IPC guidelines/SOPs	14 (100)	16 (94)	1 (33)
Provide all staff with appropriate PPE	14 (100)	16 (94)	2 (67)
Screen and triage patients	14 (100)	17 (100)	2 (67)
Provide training on IPC/PPE use	14 (100)	17 (100)	2 (67)
Regular facility disinfecting/sanitizing	14 (100)	17 (100)	3 (100)
Reorganize/increase space, patient triage for social distancing	14 (100)	11 (65)	1 (33)
Provide training on COVID-19	13 (93)	17 (100)	3 (100)
Screen staff	13 (93)	16 (94)	1 (33)
Implement COVID-19 guidelines	13 (93)	16 (94)	3 (100)
Institute disciplinary guidelines for not following procedures	7 (50)	7 (41)	2 (67)
Improve ventilation, i.e., installed fans	6 (43)	4 (24)	1 (33)
Repair/improved water supply/obtained sufficient soap	5 (36)	8 (47)	2 (67)
Re-budget/redirect funds to purchase PPE and IPC supplies	5 (36)	7 (41)	0 (0)
Other	1 (7)	0 (0)	0 (0)

In South Africa, all 14 facilities planned to implement IPC guidelines/SOPs, provide all staff with appropriate PPE, screen, and triage patients, provide training on IPC/PPE use, ensure regular facility disinfecting/sanitizing, and reorganize/increase space, and patient triage for social distancing. All, except for one facility, planned to provide training on COVID-19 and to screen staff.

All facilities in Uganda planned to screen and triage patients, provide training on IPC/PPE use, and on COVID-19, and regularly disinfect/sanitize the facility. All three facilities in Côte d'Ivoire planned regular facility disinfection/sanitizing, training on COVID-19 and to implement COVID-19 guidelines.

COVID-19 illness among health facility staff – themes from participants' comments

In what ways did IPC, or limitations in IPC, play a role in COVID-19 illness among staff?

Respondents from South Africa commented that staff not adhering to the COVID-19 protocols contributed to staff becoming ill with COVID-19. In addition, respondents noted that at the beginning of the COVID-19 pandemic, guidelines were not clear, including which PPE to use and who should use the various PPE. Some commented that confusing media messages on COVID-19 played a role, and that staff became "relaxed" with each other, grouping together, ignoring social distancing and in some instances, not wearing masks. There was also a comment that the

high volume of sick patients in the emergency department created overcrowding and exposure to the staff.

The most frequently commented limitation by the Uganda respondents was lack of PPE, followed by improper use of PPE. Other limitations were lack of training, knowledge and guidelines on COVID-19, and limited space for social distancing; maternity was given as an example, where there were many care takers.

Côte d'Ivoire respondents mentioned limitations such as lack of PPE, social distancing, and lack of systematic implementation of IPC in all departments.

What IPC policies, practices, and resources helped to address challenges related to COVID-19 illness among staff?

South African IPC-FPs commented that the National IPC Strategic Framework and COVID-19 guidelines, and SOPs helped to address these challenges. Also, training, peer education among staff, and posters were helpful, as well as adherence to the (Department of Health) guidelines. There was a comment about the availability of accommodation for staff.

In Uganda, the IPC-FPs most often commented that the availability, training on and extended use of PPE was helpful for these challenges. Other comments were screening and testing, compliance with IPC SOPs, the availability of supplies, and social distancing measures. Training (COVID-19, IPC) and supervision and monitoring was also commented on.

Côte d'Ivoire respondents mentioned that the national directives were helpful, as was the availability and use of PPE, the implementation of IPC activities (masks, social distancing, hygiene practices), training on IPC and referral of COVID-19 patients.

What IPC policies, practices, and resources would be helpful to avoid COVID-19 illness among staff in the future? [Prompts: international or national guidelines; trainings; support from district health officials, MoH, implementing partners]

In response to this question, South African respondents commented that support from the Department of Health for the national guidelines/following the guidelines would be helpful, as would training on the SOPs/guidelines. There was a comment that having patients comply with the instructions and advice would be helpful.

Ugandan respondents commented that the availability of PPE, medical supplies (advance procurement) and space/renovation/infrastructure/provision of more isolation rooms/wards, would be helpful. As would recruiting more staff, providing training, and planning for ongoing training and mentorship. There were comments also on involving staff in the management of COVID-19, surveillance, health education for patients and community vaccination.

In Côte d'Ivoire, respondents indicated that compliance with national guidelines, the provision of screening kits, availability of PPE, staff training in COVID-19 management, and planning for hospitals as places of isolation would be helpful. As would raising awareness on COVID-19 and informing the public.

Additional time needed to implement IPC procedures

The one South African facility that indicated that there had been service disruption due to the additional time needed to implement IPC procedure, (e.g., facility disinfection, equipment sterilization, etc.), reported that that this disruption lasted a median time of one week. Additional time had been needed for routine environmental cleaning, facility disinfection, ward outpatient area disinfection, and infectious waste management. The reason for the additional time needed was for identification of staff and patients with COVID-19 and was due to a shortage of trained cleaning staff.

In Uganda, no facility reported that the additional time needed to implement IPC procedures (i.e., disinfection, equipment sterilization) disrupted services. In Côte d'Ivoire, 24 (69%) facilities needed additional time to implement IPC procedures.

Implementation of physical (social) distancing requirements to reduce the risk of infection

Eleven facilities in South Africa (26%) reported that implementation of physical distancing measures disrupted services, with a median time of 92.4 weeks (IQR: 27.3, 100.3). In nearly half of the facilities (5), disruption was still ongoing. In Uganda, 17 facilities (37%) reported that implementation of distancing measures disrupted services, with a median time of 17.4 weeks (IQR: 9.7, 63.9). In four facilities (24%), this disruption was still ongoing. In 16 (46%) Côte d'Ivoire facilities, implementation of distancing procedures disrupted services, with a median time of 25 weeks (IQR: 13.0, 82.7). In one facility, disruption for this reason was ongoing at the time of data collection.

Table 16 presents physical distancing measures implemented. Over 70% of facilities (n=8) in South Africa had modified indoor space to allow for patients distancing, and to limit close staff contact. Seven facilities (64%) limited the number of patients in indoor space to allow for distancing. In Uganda, nearly all the facilities (94%) used outdoor space for distancing, and 14/16 (82%) had also limited the number of patients indoors to allow for distancing. In Côte d'Ivoire, installation of barriers and use of outdoor space (71%, n=10) were the most frequently mentioned distancing measure implemented.

Table 16: Types of physical (social) distancing measures implemented (prior to disruption)

	SA (N=11)	UG (N=17)	CDI (N=14)
Modifications of indoor space to allow for distancing between patients	8 (73)	11 (65)	8 (57)
Modification to limit close contact/gathering of staff	8 (73)	11 (65)	9 (64)
Limiting the number of patients in indoor space to allow for distancing	7 (64)	14 (82)	8 (57)
Use of outdoor space to provide for distancing in waiting rooms	5 (46)	16 (94)	10 (71)
Installation of barriers between staff/patients or patients/patients	4 (36)	9 (53)	10 (71)
Modifications to provide additional distancing between beds in wards	4 (36)	11 (65)	3 (21)
Other	1 (9)	5 (29)	5 (36)

Actions taken beforehand to reduce/mitigate the impact of the physical distancing requirements are shown in Table 17. In South Africa, all 11 facilities reorganized patient flow, and 10 used more outdoor space. Similarly, all the facilities in Uganda had reorganized patient flow, and 15/17 had used more outdoor space. Most facilities in Côte d'Ivoire reorganized patient flow (11/14) and half used more outdoor space.

Table 17: Actions taken to reduce the impact of the distancing measure on service disruption

	SA (N=11)	UG (N=17)	CDI (N=14)
Reorganized patient flow	11 (100)	17 (100)	11 (79)
Used more outdoor space	10 (91)	15 (88)	7 (50)
Used underutilized facility/space	8 (73)	11 (65)	2 (14)
Renovated facility to create more space	2 (18)	1 (6)	1 (7)
Other	1 (9)	0 (0)	2 (14)

Facility was unable to implement physical (social) distancing requirements to reduce the risk of infection

A third of South African facilities (n=14/42) reported service disruption related to inability to implement distancing requirement to reduce the risk of infection. The median time for this disruption was 4.4 weeks (IQR: 2.0, 78.3). The more frequently reported reason was lack of sufficient indoor space for patient distancing (64%), followed by an inability to provide barriers between staff/patients or patients/patients (57%), Table 18. In Uganda, five facilities (11%) had services disrupted due to inability to implement distancing requirements, with a median disruption time of 17.3 weeks (IQR: 13.1, 21.9). Two facilities (6%) in Côte d'Ivoire reported this reason for service disruption.

Table 18: Reasons facility unable to implement physical (social) distancing requirements to reduce the risk of infection (prior to disruption)

	SA (N=14)	UG (N=5)	CDI (N=2)
Lack of sufficient indoor space for distancing between patients	9 (64)	5	1
Inability to provide barriers between staff/patients or patients/patients	8 (57)	2	0
Lack of sufficient space for staff to distance from each other	7 (50)	3	2
Lack of outdoor space to provide for additional room for distancing	6 (43)	1	0
Lack of space to provide distancing between beds in wards	4 (29)	1	0
Facility provided transport for staff did not allow for distancing	1 (7)	2	0

Other	1 (7)	9	1

Table 19 presents actions taken to mitigate the inability to implement distancing requirements. In South Africa, these included reorganized patient flow, 93% of facilities, using more outdoor space, 79% of facilities and using/converting underutilized facility/space, 57% of facilities.

Table 19: Actions taken to improve/mitigate the reasons facility unable to implement physical (social) distancing requirements to reduce the risk of infection (prior to disruption)

	SA (n=14)	UG (n=5)	CDI (N=2)
Reorganized patient flow	13 (93)	5	2
Used more outdoor space	11 (79)	4	2
Used/converted under-utilized facility/space	8 (57)	2	2
Provided patients with other locations to receive services	5 (36)	0	0
Renovated facility to create more space	4 (29)	1	0
Provided care by phone instead of in person	0 (0)	0	0
Other	2 (14)	0	0

What were the main challenges to implementing physical (social) distancing?

Implementation of physical (social) distancing requirements to reduce the risk of infection – themes from participants' comments

The main challenge in implementing social distancing reported by the South African IPC-FPs was insufficient space. However, patients' lack of understanding of social distancing was also mentioned as a challenge. Ugandan respondents similarly reported lack of space as the main challenge, and they also mentioned the doctor-patient relationship where critically ill patients needed caregivers to be near to them, and large numbers of caregivers. Côte d'Ivoire IPC-FPs indicated that patient resistance/attitudes to be a challenge as well as those accompanying patients.

Reported change in use of antibiotics 2019-2020

Pharmacists' responses on how the use of antibiotics had changed in 2020, compared to 2019, are summarized in Table 20. In South Africa, 28 pharmacists responded to this question, 40 in Uganda and 20 in Côte d'Ivoire.

Most of the pharmacists in South Africa reported that in 2020 compared to 2019, total prescribing of antibiotics was somewhat/much more, 82% (n=23), as was availability of antibiotics, 53% (n=15), and the use of antibiotics for common infections, 53% (n=15). Nearly half of the pharmacists, 48% (n=13), reported that the use of antibiotics for the limited group of syndromes,

was somewhat/much more, while they were split in their reporting of antibiotic use for multidrug resistant bacteria; 35% (n=9), indicating this was somewhat/much more, 31% (n=8), that this was somewhat/much less, and 31% (n=8), that this was about the same.

In Uganda, 68% (n=27) of pharmacists reported that, compared to 2019, antibiotic prescribing was somewhat/much more in 2020, and availability of the drugs was about the same, 48% (n=19). Use of first or second-line antibiotics tended to be somewhat/much more in 2020 compared to 2019, 58% (n=23), though antibiotic use for the limited group of syndromes was about the same, 50% (n=18). Responses on the use of antibiotics for multi-drug resistant bacteria were split; 33% (n=7) of the pharmacists said it was about the same, while 38% (n=8) said it was somewhat/much more in 2020 compared with 2019.

Pharmacists in Côte d'Ivoire reported that antibiotic prescribing and availability was about the same in 2020 compared with 2019, 53% (n=10) and 56% (n=10), respectively. Similarly, for the use of antibiotics for first or second-line antibiotics (47%, n=9), for limited use (50%, n=10), and for multi-drug resistance bacteria (53%, n=9).

Table 20. Reported change in antibiotic use in 2020 compared with 2019 by pharmacists, South Africa, Uganda, and Côte d'Ivoire

	SA (n=28)	UG (n=40)	CDI (n=20)
	N (%)	N (%)	N (%)
Total prescribing of antibiotics#			
Much more	21 (75)	12 (30)	3 (16)
Somewhat more	2 (7)	15 (38)	5 (26)
About the same	1 (4)	5 (13)	10 (53)
Somewhat less	1 (4)	4 (10)	0 (0)
Much less	3 (11)	4 (10)	1 (5)
Availability of antibiotics (supply chain)#			
Much more	10 (36)	3 (8)	0 (0)
Somewhat more	5 (18)	5 (13)	7 (39)
About the same	9 (32)	19 (48)	10 (56)
Somewhat less	1 (4)	9 (23)	1 (6)
Much less	3 (11)	4 (10)	0 (0)
Use of first/second line antibiotics for common infections (WHO access – lower resistance potential)#			
Much more	9 (32)	8 (20)	3 (16)
Somewhat more	6 (21)	15 (38)	6 (32)
About the same	8 (29)	9 (23)	9 (47)
Somewhat less	1 (4)	5 (13)	1 (5)
Much less	3 (11)	3 (8)	0 (0)
Do not know	1 (4)	0 (0)	0 (0)
Use of antibiotics for limited group of syndromes (WHO watch – higher resistance potential) #			
Much more	12 (44)	4 (11)	1 (5)
Somewhat more	1 (4)	9 (25)	5 (25)
About the same	6 (22)	18 (50)	10 (50)

Somewhat less	2 (7)	3 (8)	2 (10)
Much less	4 (15)	1 (3)	0 (0)
Do not know	2 (7)	1 (3)	2 (10)
Use of antibiotics for multi- or extensively drug resistant bacteria (WHO reserve – "last resort")[#]			
Much more	6 (23)	5 (24)	1 (6)
Somewhat more	3 (12)	3 (14)	3 (18)
About the same	8 (31)	7 (33)	9 (53)
Somewhat less	2 (8)	5 (24)	1 (6)
Much less	6 (23)	1 (5)	2 (12)
Do not know	1 (4)	0 (0)	1 (6)

[#]Missing responses: Total prescribing of antibiotics, CDI n=1; Availability of antibiotics (supply chain), CDI n=2; Use of first/second line antibiotics for common infections, CDI n=1; Use of antibiotics for limited group of syndromes, SA n=1, UG n=4; Use of antibiotics for multi- or extensively drug resistant bacteria, SA n=2, UG n=19, CDI n=3.

Reported COVID-19 related disruption of AMR systems and processes

Laboratory directors' responses to questions about changes affecting AMR activities (diagnostics, testing, AMR resistance rates) and laboratory operations (supplies, equipment, training, budgets/funding) from before the COVID-19 pandemic to the worst time during the COVID-19 pandemic, are presented in Tables 21-28. Nineteen South African, 12 Ugandan and two Ivoirian directors responded to the questionnaire. Due to the small number, the Ivorian responses have been excluded.

The South African laboratory directors reported an increase in the routine microbiology workload, Table 21. They reported observing a longer turn-around time in antimicrobial susceptibility results. Laboratory directors in Uganda reported a decrease in the routine microbiology workload and in the screening cultures to detect multidrug resistance organisms, and a reduced ability to carry out routine laboratory quality management activities.

Table 21: Impact of COVID-19 on AMR activities in the laboratory

	SA (N=19) N (%)	UG (N=12) N (%)
Number of clinical cultures (i.e., routine microbiology) #		
Much less	5 (33)	8 (73)
About the same	2 (13)	2 (18)
Somewhat more	2 (13)	1 (9)
Much more	6 (40)	0 (0)
Number of screening cultures to detect multidrug resistant (MDR) organisms#		
Much less	5 (33)	5 (42)
Somewhat less	0 (0)	3 (25)
About the same	5 (33)	2 (17)
Somewhat more	2 (13)	1 (8)
Much more	2 (13)	1 (8)
Do not know	1 (7)	0 (0)
Turn-around time for antimicrobial susceptibility results#		
Much longer time	3 (20)	1 (8)
Longer time	4 (27)	2 (17)
About the same time	6 (40)	8 (67)
Shorter time	1 (7)	0 (0)
Much shorter time	1 (7)	1 (8)
Ability to carry out routine laboratory quality management#		
Much reduced	2 (11)	3 (25)
Reduced	5 (26)	4 (33)
About the same	4 (21)	4 (33)
Increased	4 (21)	0 (0)
Significantly increased	4 (21)	1 (8)
Ability to carry out molecular testing* for MDR organisms#		
Much less	1 (11)	0
Somewhat less	1 (11)	2
About the same	4 (44)	1
Somewhat more	2 (22)	1
Much more	0 (0)	0
Do not know	1 (11)	0

*Including whole genomic sequencing. #Missing responses: Number of clinical cultures, SA n=4, UG n=1; Number of screening cultures to detect MDR organisms, SA n=4; Turn-around time for antimicrobial susceptibility results, SA n=4; Ability to carry out routine laboratory quality management, SA n=4, UG n=1; Ability to carry out molecular testing for MDR organisms, SA n=10, UG n=8.

Table 22 presents responses on the changes in the availability of laboratory supplies and equipment. The South African laboratory directors reported that availability of laboratory reagents/consumables for bacteriology and antimicrobial susceptibility testing was less as was the ability to service the machines and equipment. Similar numbers of pharmacists in Uganda reported less, and more availability of supplies and equipment.

Table 22. Changes in availability of laboratory supplies and equipment

	SA (N=19)	UG (N=12)
	N (%)	N (%)
Availability of reagents/consumables/discs for bacteriology and antimicrobial susceptibility[#]		
Much less	5 (28)	2 (17)
Somewhat less	3 (17)	2 (17)
About the same	6 (33)	5 (42)
Somewhat more	1 (6)	2 (17)
Much more	1 (6)	1 (8)
Do not know	2 (11)	0 (0)
Availability of specimen collection supplies for culture testing[#]		
Much less	4 (24)	3 (25)
Somewhat less	3 (18)	2 (17)
About the same	7 (41)	5 (42)
Somewhat more	2 (12)	2 (17)
Much more	1 (6)	0 (0)
Ability to service the machines and equipment		
Much less	8 (42)	4 (33)
Somewhat less	3 (16)	0 (0)
About the same	7 (37)	8 (67)
Somewhat more	0 (0)	0 (0)
Much more	1 (5)	0 (0)
Access to advanced diagnostic technologies[#]		
Somewhat less	2 (13)	2 (25)
About the same	6 (40)	4 (50)
Much more	4 (27)	2 (25)
Do not know	3 (20)	0 (0)

[#]Missing responses: Availability of reagents/consumables/discs for bacteriology and antimicrobial susceptibility, SA n=1; Availability of specimen collection supplies for culture testing, SA 2; Access to advanced diagnostic technologies, SA n=4, UG n=4.

When laboratory directors asked if there had been changes in staff availability for AMR activities, directors in South Africa and Uganda reported that staffing at the senior levels had remained about the same, while those at mid-level were less. Junior level staff in SA were less, while in Uganda, some pharmacists reported more, and some, less. These findings are presented in Table 23.

Table 23. Changes in availability of laboratory staff responsible for AMR activities

	SA (N=19)	UG (N=12)
	N (%)	N (%)
Senior staff (i.e. department heads, laboratory director)[#]		
Much less	1 (7)	1 (8)
Somewhat less	2 (14)	2 (17)

About the same	8 (57)	7 (58)
Somewhat more	1 (7)	2 (17)
Much more	1 (7)	0 (0)
Do not know	1 (7)	0 (0)
Mid-level staff (4 years or more)[#]		
Much less	2 (14)	1 (8)
Somewhat less	3 (21)	4 (33)
About the same	7 (50)	5 (42)
Somewhat more	0 (0)	1 (8)
Much more	1 (7)	1 (8)
Do not know	1 (7)	0 (0)
Junior staff (3 years or less)[#]		
Much less	3 (20)	0 (0)
Somewhat less	2 (13)	3 (27)
About the same	6 (40)	5 (46)
Somewhat more	1 (7)	0 (0)
Much more	2 (13)	3 (27)
Do not know	1 (7)	0 (0)

[#]Missing responses: Senior staff, SA n=5; Mid-level staff, SA n=5; Junior staff, SA n=4, UG n=1

Changes in training and mentorship are presented in Table 24. In South Africa, in-person training courses were much less (68%), while there was much more virtual training (58%). Mentorship activities remained about the same, as well as in-person training for internal quality control (QC). Internal virtual QC training was reported to be more, while both external QC in-person and virtual training activities were about the same.

According to the Uganda laboratory directors, in-person and virtual training activities were less. Mentorship remained about the same, as were internal QC in-person and virtual trainings. External QC training in-person was much less, while virtual training was less.

Table 24. Changes in training and mentorship activities

	SA (N=19)	UG (N=12)
	N (%)	N (%)
Training activities: in-person courses (except for QC/EQA*)		
Much less	13 (68)	4 (33)
Somewhat less	2 (11)	5 (42)
About the same	3 (16)	1 (8)
Somewhat more	1 (5)	2 (17)
Much more	0 (0)	0 (0)
Training: virtual (except for QC/EQA*)		
Much less	3 (16)	4 (33)
Somewhat less	1 (5)	2 (17)
About the same	3 (16)	2 (17)
Somewhat more	1 (5)	2 (17)
Much more	11 (58)	2 (17)
Mentorship i.e. coaching, individual guidance (except for QC/EQA)		

Much less	11 (58)	4 (33)
Somewhat less	1 (5)	3 (25)
About the same	6 (32)	4 (33)
Somewhat more	0 (0)	0 (0)
Much more	1 (5)	1 (8)
Internal QC: in-person training		
Much less	5 (26)	3 (25)
Somewhat less	3 (16)	3 (25)
About the same	11 (58)	4 (33)
Somewhat more	0 (0)	0 (0)
Much more	0 (0)	2 (25)
Internal QC: virtual training		
Much less	1 (5)	6 (50)
Somewhat less	2 (11)	0 (0)
About the same	6 (32)	4 (33)
Somewhat more	3 (16)	2 (33)
Much more	7 (37)	0 (0)
External QC: in-person training		
Much less	5 (26)	6 (50)
Somewhat less	0 (0)	2 (17)
About the same	14 (74)	2 (17)
Somewhat more	0 (0)	1 (8)
Much more	0 (0)	1 (8)
Do not know	0 (0)	0 (0)
External QC: virtual training[#]		
Much less	1 (6)	4 (33)
Somewhat less	0 (0)	1 (8)
About the same	10 (56)	4 (33)
Somewhat more	2 (11)	2 (17)
Much more	5 (28)	1 (8)

*QC/EQA: Quality Control/External Quality Assurance. [#]Missing responses: External QC: virtual training, SA n=1.

Changes in IPC practices and availability of IPC supplies to reporting laboratories are shown in Table 25. In both South Africa and Uganda there was increased compliance with hand hygiene, increased availability of alcohol-based hand rub and of masks/respirators, gloves, and gowns.

Table 25. Changes in IPC practices and availability of IPC supplies in laboratories from 2019 to 2020

	SA (N=19)	UG (N=12)
	N (%)	N (%)
Compliance with hand hygiene		
About the same	1 (5)	0 (0)
Somewhat more	0 (0)	2 (17)
Much more	18 (95)	10 (83)
Availability of alcohol-based hand rub		
About the same	1 (5)	0 (0)
Somewhat more	0 (0)	1 (8)
Much more	17 (90)	11 (92)
Do not know	1 (5)	0 (0)

Availability of Personal Protective Equipment (PPE): masks, respirators		
Much less	1 (5)	0 (0)
Somewhat less	3 (16)	1 (8)
About the same	3 (16)	0 (0)
Somewhat more	0 (0)	3 (25)
Much more	11 (58)	7 (58)
Do not know	1 (5)	1 (8)
Availability of PPE: gowns		
Somewhat less	2 (11)	1 (8)
About the same	2 (11)	1 (8)
Somewhat more	0 (0)	2 (17)
Much more	15 (79)	8 (67)
Availability of PPE: gloves		
Somewhat less	3 (16)	2 (17)
About the same	1 (5)	1 (8)
Somewhat more	2 (11)	0 (0)
Much more	13 (68)	9 (75)

Directors were asked about changes in antimicrobial resistance rates. Of the South African laboratories, 48% (9/19), calculated overall antimicrobial resistance rates, for example, annual cumulative antibiograms. Overall, the rates were reported to be about the same, Table 26. Four laboratories in Uganda calculated these rates.

Table 26. Changes in antimicrobial resistance rates in laboratories from 2019 to 2020

	SA (N=9)	UG (N=4)
	N (%)	N (%)
Escheria coli: fluoroquinolones[#]		
Much less	2 (22)	0
About the same	6 (67)	1
Much more	0 (0)	2
Do not know	1 (11)	0
Escheria coli: cephalosporins[#]		
Much less	2 (22)	0
About the same	5 (56)	1
Somewhat more	1 (11)	0
Much more	0 (0)	1
Do not know	1 (11)	0
Escheria coli: carbapenems[#]		
Much less	1 (13)	1
About the same	5 (63)	1
Somewhat more	1 (13)	0
Much more	1 (13)	0
Klebsiella pneumoniae: cephalosporins[#]		
Much less	3 (33)	0
About the same	5 (56)	1
Somewhat less	0 (0)	1
Somewhat more	1 (11)	1
Klebsiella pneumoniae: carbapenems[#]		

Much less	1 (13)	1
About the same	4 (50)	1
Somewhat more	1 (13)	0
Much more	2 (25)	0
Acinetobacter spp: cephalosporins[#]		
Much less	1 (11)	0
Somewhat less	0 (0)	1
About the same	5 (56)	1
Somewhat more	2 (22)	0
Much more	1 (11)	0
Acinetobacter spp: carbapenems[#]		
Much less	0 (0)	1
About the same	5 (63)	1
Somewhat more	2 (25)	0
Much more	1 (13)	0
Staphylococcus aureus: penicillins[#]		
About the same	5 (56)	1
Somewhat more	1 (11)	0
Much more	3 (33)	2
Missing	0 (0)	1
Staphylococcus aureus: cephalosporins[#]		
Somewhat less	0 (0)	1
About the same	5 (56)	1
Somewhat more	1 (11)	0
Much more	2 (22)	1
Do not know	1 (11)	0
Streptococcus pneumoniae: penicillins[#]		
Much less	1 (11)	0
About the same	7 (78)	1
Much more	1 (11)	2
Streptococcus pneumoniae: macrolides/azalides[#]		
Much less	1 (11)	0
About the same	7 (78)	2
Somewhat more	1 (1)	0
Much more	0 (0)	1
Salmonella spp: fluoroquinolones[#]		
About the same	9 (100)	1
Somewhat more	0 (0)	1
Shigella spp: fluoroquinolones[#]		
About the same	9 (100)	1
Much more	0 (0)	1
Neisseria gonorrhoeae: cephalosporins[#]		
About the same	5 (56)	1
Somewhat more	0 (0)	1
Do not know	4 (44)	0
Multi-drug resistant healthcare infections: Colistin[#]		
About the same	5 (63)	1
Somewhat more	2 (25)	0
Do not know	1 (13)	0

[#]Missing responses: Escheria coli: fluoroquinolones, UG n=1; Escheria coli: cephalosporins, UG n=2; Escheria coli: carbapenems, UG n=2; Klebsiella pneumoniae: cephalosporins, UG n=1; Klebsiella pneumoniae: carbapenems, SA

n=1, UG n=2; Acinetobacter spp: cephalosporins, UG n=2; Acinetobacter spp: carbapenems, SA n=1, UG n=2; Staphylococcus aureus: penicillin, UG n=1; Staphylococcus aureus: cephalosporins, UG n=1; Streptococcus pneumoniae: penicillin, UG n=1; Streptococcus pneumoniae: macrolides/azalides, UG n=1; Salmonella spp: fluoroquinolones, UG n=2; Shigella spp: fluoroquinolones, UG n=2; Neisseria gonorrhoeae: cephalosporins, UG n=2; Multi-drug resistant healthcare infections: Colistin, SA n=1, UG n=3.

Laboratory respondents were asked if they had sent samples out for testing between February 2019 and March 2021. From a total of 18 laboratories in South Africa, 8 (44%) had sent samples out for testing. In Uganda, two out of 11 laboratories (18%) sent samples out for testing. The median number and interquartile range (IQR) of the samples sent out in 2019 and 2020 is presented in Table 27.

In South Africa, the number of samples collected and sent out for testing in 2020 was about half of the number of samples collected and sent out for testing in 2019. When asked about why the numbers sent out for testing was less in 2020 than in 2019, five of the 8 laboratories indicated "other" reasons, one laboratory indicated insufficient staff, and one because of a supply shortage.

In Uganda, the number of samples sent out for testing in 2020 was more than in 2019. The reasons for this were that there had been a supply shortage in one laboratory, and for "other" reasons in the other laboratory. However, the number of samples processed in 2020 was less than in 2019.

Table 27: Number of samples* sent out for testing in laboratories from 2019 to 2020, median and IQR

Median (IQR)		
	SA (N=8)	UG (N=2)
Samples collected (2019)	28,586 (9,619, 135,543)	187,522 (102,486, 272,557)
Samples processed in the lab (2019)	0 (0, 67,528)	186,886 (101,215, 272,557)
Samples sent out for testing (2019)	27,600 (9,619, 69,000)	636 (0, 1271)
Samples collected (2020)	14,788 (5,632, 126,540)	166,240 (106,225, 226,254)
Samples processed in the lab (2020)	0 (0, 65,540)	164,880 (103,505, 226,254)
Samples sent out for testing (2020)	14,788 (5,632, 62,000)	1,360 (0, 2,720)

*May have included sexually transmitted disease, TB, HIV, as well as AMR samples.

Laboratory directors/managers summarized responses to changes in overall budget/funding availability specifically for AMR in 2020 compared to 2019 are presented in Table 28. Overall, there appeared to be no changes in funding/budget availability in South Africa, which remained about the same, while in Uganda there was a trend of lower resource availability for AMR.

Table 28. Changes in overall availability of budget/funding for AMR in laboratories from 2019 to 2020

	SA (N=15)*	UG (N=12)
	N (%)	N (%)
Overall availability of budget/funding for AMR		
Much less	0 (0)	2 (17)
Somewhat less	0 (0)	2 (17)
About the same	11 (73)	6 (50)
Somewhat more	0 (0)	2 (17)
Do not know	4 (27)	0 (0)
Availability of budget/funding for training in AMR#		
Much less	1 (7)	3 (27)
Somewhat less	2 (13)	3 (27)
About the same	7 (47)	5 (46)
Somewhat more	1 (7)	0 (0)
Do not know	4 (27)	0 (0)
Availability of budget/funding for AMR equipment		
Much less	0 (0)	3 (25)
Somewhat less	0 (0)	2 (17)
About the same	10 (67)	6 (50)
Somewhat more	1 (7)	0 (0)
Much more	1 (7)	1 (8)
Do not know	3 (20)	0 (0)
Availability of budget/funding for AMR supplies		
Much less	0 (0)	3 (25)
Somewhat less	0 (0)	3 (25)
About the same	10 (67)	5 (42)
Somewhat more	1 (7)	0 (0)
Much more	0 (0)	1 (8)
Do not know	4 (27)	0 (0)_
Availability of budget/funding for other AMR activities#		
Much less	0 (0)	3 (27)
Somewhat less	0 (0)	3 (27)
About the same	11 (73)	5 (46)
Do not know	4 (27)	0 (0)

*Missing responses SA n=4. Missing responses UG: Availability of budget/funding for training in AMR, n=1, Availability of budget/funding for other AMR activities, n=1.

Laboratory managers/directors were asked if there had been changes in the AMR data information systems between 2019 to 2020. Specifically, in the procedures and infrastructure of laboratory information systems for AMR reporting and for the hospital clinical information system (HIS/EMR) for the AMR response. Of the 15 responses received from South Africa, 11 (73%) indicated that the laboratory information system for AMR reporting was about the same, one (7%) reported somewhat more changes to the procedures and infrastructure, and three (20%) did not

know. Similarly, 11 (79%) said the hospital clinical information system was the same, one (7%) reported somewhat more, and two (14%) did not know. Of 12 responses from Uganda, 10 (83%) said that laboratory information system for AMR was about the same, one (8%) said it was somewhat less, one (8%) that it was much less. Concerning the hospital clinical information system, 11 (92%) said it was about the same, and one (8.3%) that it was somewhat less.

When asked if prioritization of AMR by the MOH had changed from 2019 to 2020, seven (39%) South African managers said it had not changed, two (11%) stated that AMR had become much less of a priority, two (11%) reported that it had become much more of a priority, and seven (39%) did not know. In Uganda, four (36%) managers indicated that prioritization was much less, one (9%) that is somewhat less, four (36%) that it was about the same, and two (18%) that it was somewhat more.

Facility attendance by service delivery over time

Figures 1- 60 in Appendices 1-3 present attendance records for selected services at primary, secondary and tertiary levels of care, overlayed with reported COVID-19 cases.

South Africa

The following service delivery and attendance records are presented in Figures 1-27 in Appendix 1 for South Africa by primary, secondary and tertiary levels of care: HIV tests (Figures 1-3), newly initiated HIV patients on antiretroviral therapy (ART), disaggregated by children <15 years (Figures 4-6), and adults 15+ years (Figures 7-9) , ART continuation disaggregated by <15 and 15+ years (Figures 10-15), ANC attendance (Figures 16-18), and screening for cervical cancer (Figures 19-21), diabetes, hypertension, and TB (Figures 22-27). At the primary care facilities, HIV testing declined with the first COVID-19 wave; this decline was substantial in Gauteng province. Declines were also observed with the second and third waves, though these were smaller. However, a steep decline appeared to be associated with the fourth COVID-19 wave. Over the entire observation period, HIV testing seemed to have declined. A similar pattern showing a decrease with the COVID-19 waves was also observed at secondary and tertiary levels, with steep declines with the first wave, and lesser declines in subsequent waves, except for the fourth wave. At tertiary level facilities, the overall level of testing appeared to be constant.

Similar, though less obvious trends were observed for both child and adult patients newly initiated on ART, at all levels of care. Notably, the number of adults newly initiated on ART were declining prior to the COVID-19 pandemic, particularly at secondary and tertiary facilities.

The aggregate attendance for ART continuation appeared to remain steady throughout the observation period, and not impacted by COVID-19. However, there appears to be a decline over time at all levels for the children on ART.

Cervical cancer screening was similarly affected by the COVID-19 waves, particularly the first one, and this was apparent at all levels of care. ANC attendance appeared to be negatively associated with the COVID-19 waves, though this was visible at the primary and tertiary care levels. Diabetes screening appeared not to be associated with the COVID-19 waves at any of the levels of care. TB screening appeared to have been affected by the COVID-19 waves also, though this may be more visible at the primary and tertiary levels of care.

Uganda

Figures 28-41 in Appendix 2 present the graphs of attendances for ANC (Figures 28-30), immunizations (Figures 31-32), screening for hypertension (Figures 33-35), diabetes (Figures 36-38) and TB (Figures 39-41) for Uganda, by primary, secondary and tertiary levels of care. Across all levels of care, ANC attendance appeared to decline in May/June 2021, associated with the second COVID-19 wave in that country. There also appears to be a sharp dip in attendances in April 2020. Immunization attendance exhibited a similar trend, including the decline in April 2020. At all care levels, hypertension attendance showed no clear trends except that there appeared to be a decrease with the second COVID-19 wave in May/June 2021.

Attendance for diabetes care at primary and secondary levels declined around the first quarter of 2020, with a slight uptake prior to the first COVID-19 wave, but then declined at that time and subsequently remained at the depressed levels, with very few attendances for the remainder of the observation period. At tertiary care levels, attendance showed the sharp decrease in April 2020, increases again, then decreases that appeared to be associated with the second COVID-19 wave in May/June 2021. TB attendance (recorded by quarter) did not appear to show an increase or decrease with the COVID-19 waves.

Côte d'Ivoire

Figures 42-60 in Appendix 3 present the Côte d'Ivoire graphs for ANC attendance (Figures 42-44), HIV care (Figures 45-47), hypertension (Figures 48-50) and diabetes care (Figures 51-53), malaria care (Figures 54-56), TB (Figure 57) and outpatient (OPD) attendances (Figures 58-60), by primary, secondary and tertiary levels of care. TB attendance by tertiary care level is not presented as there were no data available.

Overall, for all conditions and levels of care, there were decreases in attendances prior to the first COVID-19 wave in June/July 2020, and there was a sharp decrease in attendances in January/February 2021. The decrease in attendance with waves of infection was more apparent at secondary and tertiary levels of care.

Discussion

In summary, at least 70% of health facilities in the three countries surveyed reported at least one service disruption for any reason; over 80% of these facilities had at least one IPC-related reason for a disruption. Disruptions occurred across almost all health service delivery areas.

ANC was particularly affected in all three countries; PNC and NCDs were also affected in South Africa and Uganda, as was non-emergency surgery and other community outreach services in South Africa, routine immunizations in Uganda and HIV care and treatment services in both Uganda and Côte d'Ivoire. These findings are generally consistent with those from the WHO survey, where over 50% of countries reported disruption to primary care services, 59% disruption to elective surgeries, and 54% to community care (9). Some of the differences between the service delivery areas disrupted across the countries are that in South Africa, fewer primary care facilities were selected, compared to Uganda and Côte d'Ivoire (for example, routine immunization are more available in the primary care facilities).

In all three countries, limiting patient volumes were among the most frequently reported service disruptions along with reductions in service staff and service hours in Uganda and Côte d'Ivoire; and in South Africa other frequently reported types of service disruptions were service suspension and reductions in service scope. The differences in the types of frequently reported service disruption between South Africa and the other countries may have been because there were fewer primary care facilities selected (thus more hospitals), and possibly also as the COVID-19 pandemic was more severe in this country, even with differences in testing rates and reported deaths. As at the end of December 2021, South Africa had, since the start of the epidemic, experienced 3.46 million cumulative confirmed cases and 91,061 cumulative deaths, as compared with Uganda with 140,737 cumulative cases and 3,291 deaths, and Côte d'Ivoire with 71,004 cumulative cases and 712 deaths (10). This suggests cumulative incidence case rates of 570, 30 and 25 per 10,000 population, and death rates of 150, seven and three per 100,000 population, respectively for South Africa, Uganda, and Côte d'Ivoire.

The overall severity of disruption was low-to-moderate (<50% services disrupted), consistent with the WHO findings (9). However, the disruption of service scope was reported to be severe in Uganda. This may have been due to resource constraints as Uganda, in particular reported shortages in PPE and IPC material and supplies.

Ward closures had the longest median duration of disruption; 46 weeks in South Africa and 20 weeks in Uganda. Closures obviously severely disrupt services, however, there were relatively few ward closures, so that overall, the impact may not have been significant. The minimum median duration were 14 and 15 weeks due to service hours reduced in South Africa and Uganda respectively, and three weeks because of service suspension in Côte d'Ivoire. Of the three countries, Côte d'Ivoire experienced the least severe COVID-19 epidemic (11), which may be reflected in the shorter duration of disruption. Though these were the minimum durations, they still represent a substantial amount of time; nearly four months in South Africa and Uganda, during which services were disrupted.

Implementing IPC directives, COVID-19 illness among patients and among staff, and implementing social distancing measures were the most frequently reported IPC-related reasons for service disruption. In Côte d'Ivoire, another commonly reported reason was the additional time needed to implement COVID-19 prevention procedures. Non-IPC related directives were frequently reported reasons for service disruption in all three countries, as were mandated travel restrictions, and conversion to COVID-19 center/units in Uganda.

In addition to hand and facility hygiene and the use of PPE, many of the IPC directives were focused on limiting patient volumes, suspending services, and social distancing measures. In and of themselves, these actions are likely to have disrupted services. This situation may have been exacerbated by the volume and frequency of directives, as knowledge of the infection dynamics of the SARS-CoV-2 virus evolved. The WHO survey found that globally about half of the reported disruptions (51%) resulted from intentional service modifications, such as suspension of services (9).

More than a third of IPC-FPs in South Africa and Uganda reported disruption due to IPC directives, and the median disruption times ranged from 28 to 17 weeks. Less than 10% of IPC-FPs in Côte d'Ivoire reported this reason for disruption, possibly reflecting the lower prevalence of COVID-19 infection in that country compared to South Africa and Uganda. Concerning non-IPC directives, (containment strategies such transport, movement and gathering restrictions), a study has shown that these policies were associated with health service disruptions across ten countries (12). Conversion to a COVID-19 center or unit, may have meant certain areas of the facility being reserved for COVID-19 patients (thus disrupting existing services) and additional processes or procedures, such as increased physical distancing, routing through the facility, and changes in staffing.

In many facilities the volume of patients who may have been ill with COVID-19 challenged the ability to identify and isolate these patients. While this affected all three countries, this reason for service disruption was especially reported in Uganda. The facilities used standard screening procedures of temperature checks and a fever screening questionnaire. However, while the three South African facilities that reported this reason for disruption used both methods of screening, only half of the 16 Uganda facilities reporting this reason for disruption used a screening questionnaire as well as temperature checks. Temperature checks alone are an unreliable method of screening for COVID-19 (11); even when used in conjunction with a screening questionnaire (13). SARS-CoV-2 antigen-detection rapid diagnostic tests (RDTs) could be utilized in place of temperature checks for symptomatic patients. In both symptomatic and asymptomatic situations, in-patients should be initially screened with a screening questionnaire.

Reported constraints in the identification and isolation of patients for COVID-19 include insufficient staff for these additional tasks, especially in South Africa and Uganda, insufficient space for isolation of patients (Uganda, Côte d'Ivoire), lack of testing equipment, supplies, and PPE (Uganda, Côte d'Ivoire), and non-compliant patients (all three countries). Given the shortage of health personnel in the African region, already limited numbers of staff were required to take on the additional tasks of screening, triaging, and isolating patients (14). Some of the ways to ameliorate this situation is to engage volunteers/auxiliary personnel for the screening and triaging activities, after effective training. Countries that experienced large waves of COVID-19 infection utilized tents and, in some instances, containers to isolate sick patients. The use of tents and other structures that could be rapidly assembled for these purposes could be further explored as part of response to outbreaks of infectious conditions, like SARS-CoV-2.

The lack of resources (testing equipment and supplies and PPE), reported as a particular challenge by Uganda and Côte d'Ivoire, partly reflects these countries income levels (low and lower middle income). Attention should be focused on how to rapidly make necessary resources available in the event of surges of COVID-19 or other similar conditions in the future.

Non-compliant patients, and their relatives, were reported as another challenge. Patient management is a key component of identifying and isolating those with COVID-19 illness, and this could be aided using volunteers or auxiliary staff to screen, while professional staff direct

these activities and coordinate the necessary communication messages. Communication is a critical strategy in engaging patient compliance.

Facilities that reported COVID-19 illness among staff as a reason for service disruption screened staff using a questionnaire, and in some cases, temperature checks independently or in conjunction with the questionnaire. In Côte d'Ivoire, a few facilities screened staff with "other" methods. Staff testing positive were required to home isolate in most cases, though in some facilities, staff were able to isolate there. Temperature checks on their own, however, are an unreliable screening method. Symptomatic as well as asymptomatic staff with known exposure should be screened with rapid diagnostic tests. However, some facilities indicated that testing was not done because of a lack of test kits or the need to prioritize their use. The availability of test kits to screen staff is an important consideration to be able to reduce the risk of COVID-19 illness among staff, and among patients. For staff and patients, however, the use of masks indoors and in close contact situations (<6 feet) and handwashing should be required, and the messaging and encouragement for staff to stay home if not feeling well.

Few facilities overall, (though 24 in Côte d'Ivoire, but only four in Uganda and one in South Africa), reported additional time needed to implement IPC procedures such as environmental cleaning, facility disinfection, infectious waste management as a reason for service disruption. The South African facility reporting this reason, indicated that it was because of a shortage of trained cleaning staff. As part of an IPC protocol/response plan, arrangements should be detailed as to whom and how cleaning, disinfecting and waste management would be handled. No reasons were reported by the Côte d'Ivoire and Uganda facilities.

Antibiotic dispensing

Interviews with hospital pharmacists suggested increased use of antibiotics in 2020 compared with 2019 in South Africa and Uganda, but mixed views in Côte d'Ivoire. The findings in the former two countries are consistent with what has been reported in the early phase of the COVID-19 epidemic (15, 16). A recent study analyzing pharmaceutical sales data of antibiotics in 71 countries, found that antibiotic sales were positively associated with COVID-19 cases globally during 2020–2022 (17). The fact that Côte d'Ivoire may have experienced less of the epidemic than the other two countries, and with the waves peaking later in time, may explain the different results from this country. The finding that there was no reported increase in the use of antibiotics for multi-drug resistant bacteria may be consistent with the finding that bacterial co-infection among patients with severe COVID-19 was not common (18). However, a systematic review and meta-analysis documented a high prevalence of antimicrobial resistance in patients with COVID-19 and bacterial infections, with the proportion of infections resistant to antimicrobials being 60.8% (95% CI 38.6–79.3) and the proportion of resistant isolates being 37.5% (26.9–49.5) (19).

AMR testing

AMR testing systems were disrupted in both South Africa and Uganda by the COVID-19 pandemic, though the nature and extent of the disruption varied. South Africa respondents reported increased workload and ability to undertake routine laboratory quality management activities, and longer TAT in antimicrobial susceptibility results, in 2020 compared with 2019. Uganda respondents on the other hand, reported decreased workload (fewer clinical cultures), fewer screening cultures to detect multidrug resistant organisms, and reduced ability to carry out routine quality management activities and to carry-out molecular testing for multidrug resistant organisms. TAT remained the same. Though both countries implemented non-pharmaceutical interventions (for example, "lockdowns") strategies, with South Africa's among the most stringent in the world, these differences may be related to the nature of the COVID-19 responses and the different socio-economic capacities of the countries (20). In Uganda, the health sector was allocated a smaller proportion of funding for the COVID-19 response than expected (21). The lockdowns exacerbated the poverty levels in the country, so that people were not willing or able to access health services. The gross domestic product per capita in Uganda in 2021 was estimated to be $884, while that of South Africa's was $7,055, (22).

There was less availability of reagents/consumables in South Africa, and in 42% of laboratories, reduced supplies, and overall reduced ability to service the machines, while in Uganda, about a third of the laboratories reported less availability of consumables and 42% had shortages of supplies. Global supply chain shortages may have contributed to the reduced availability of supplies and consumables in both countries. Training had shifted to virtual activities in South Africa, including for internal QC, while in Uganda, training overall, (including external QC) was less, though internal QC training remained the same. In both countries, mentorship was less. Training was impacted by the COVID-19 situation with training shifting to virtual where possible or being reduced possibly due to reductions AMR related activities.

In both Uganda and South Africa, fewer samples were collected, and in South Africa, fewer samples were sent out for testing, while in Uganda, more samples were sent out for testing, though fewer samples were processed in the laboratory. This suggests that in South Africa, and in Uganda in terms of samples collected, AMR activities were negatively affected, possibly by the overall context of constraints on movement. However, it is likely that respondents reported on all laboratory samples collected and processed not just bacterial samples, given the large number of samples reported on. As would be expected, there was increased compliance with IPC practices and increased availability of IPC supplies, in both countries. There were also no changes in overall funding/budget availability or specific areas of training, equipment, supplies, and other activities associated with bacterial culture and sensitivity testing, suggesting no diversion of resources from these areas.

Facility attendance across selected service delivery points by time

Across all three countries, there was an inverse relationship between facility attendance and the COVID-19 waves. Attendances for cervical cancer and TB screening, ANC, childhood immunizations, hypertension and diabetes care appeared to be more affected.

In South Africa, a study found that some of the disruption may have been a result of mandated constraints of overall movement in South Africa ("lockdowns"), especially with the first COVID-19 wave (23). The disruption was especially visible for HIV testing, where attendance declined during the COVID-19 waves across all levels of care, but particularly primary care level, and the first and fourth waves. There was a similar pattern observed for attendances for ART initiation which may be a result of the reduction in testing which would lead to reduction in identification and initiation of HIV positive patients. Attendance, however, for ART care continuation remained constant generally, and appeared to be minimally affected by the COVID-19 waves. These findings are consistent with that from studies in South Africa (24, 25). The Global Fund reported that globally, HIV testing services declined by 41% in 2020 compared with 2019 (26). Patients may have prioritized the collection of ART medication as they were already engaged in HIV care and possibly aware of the importance of maintaining high adherence. In addition, health facilities may have maintained ART provision through multi-month prescribing and differentiated service provision (20). Studies in Uganda, Kenya and South Africa suggested that reductions in testing could have been due to a lack of PPE, as well as limited space for distancing in health facilities, reduced clinic opening times and staff being redeployed from HIV testing to COVID-19 response activities (26, 27, 28, 29). In South Africa, however, shortages of PPE overall may not have been a limitation. Limited space for social distancing, and the redeployment of staff may have disrupted services. These limitations could be mitigated with increased use of barriers as mentioned earlier, and with the addition of staff resources. Attendance for cervical cancer and TB screening similarly declined during the COVID-19 waves, particularly the first wave for both, and the third wave for TB.

In Uganda attendance by service delivery points for ANC, immunization, hypertension, and diabetes at all care levels, but more visibly at secondary/tertiary levels, seemed also to decline during the COVID-19 waves, particularly the second wave. In almost all instances, there was a steep decrease in attendance in May 2020, prior to the first wave. This was a consequence of a government lockdown to try to reduce transmission of SARS-CoV-2, originally implemented March 30, 2020, and extended three times to the end of May 2020 (30). The apparent decline of attendances with the COVID-19 waves at the higher levels of care, may be due to increased social distancing measures in these facilities, reduction of services, etc. Many of these facilities are in urban areas, with greater population densities and consequent risk of infection.

In Côte d'Ivoire the inverse relationship of facility attendances and levels of COVID-19 was also more apparent at higher levels of care. This is likely due to the same reasons as in Uganda; these facilities, more likely to be hospitals, probably implemented more interventions to reduce infection risk, than the lower levels facilities, as they were likely to be urban based. The steep decline at

the end of 2021, which appeared to coincide with the second COVID-19 wave at the end of 2021, is more likely to be associated with the normal decline in attendance in Abidjan at this time (31).

Limitations

There are several limitations to the study. We oversampled hospitals, as these types of facilities offer a range of health services to be able to demonstrate disruption. Therefore, the findings may not be representative of lower-level facilities which are more prevalent in these countries. Also, we sampled provinces/regions with the highest levels of confirmed COVID-19 cases; these areas may not be representative of all areas in the respective countries. We only sampled public, not-for-profit facilities; for-profit facilities may not have experienced the same level or type of disruptions. We also did not measure change in demand for healthcare services. Other limitations include the lag time between occurrence of disruption and the time of survey administration may contribute to bias, potential response bias from primarily relying on interviews and recall, and that personnel may have changed since the period of disruption. Finally, the data on laboratory samples collected and tested may have included non-microbiological samples.

The reported disruptions and the use of antibiotics may be prone to desirability bias; we did not capture specific data on the actual amounts and types of antibiotics dispensed, nor data on all the attendances by service delivery point. However, a strength of the study is that it provides evidence of health services disruption associated with COVID-19 at the facility level in three countries from different regions in Africa, and reasons for the IPC-related disruptions.

Conclusion

Over 70% of health facilities in the three countries reported at least one service disruption for any reason; over 80% of which were IPC-related. Disruption occurred across almost all health service delivery areas. Limiting patient volumes was among the most frequently reported service disruptions; other reported disruptions varied by country. The overall severity of disruption was low-to-moderate, ward closures had the longest median disruption time. Implementing IPC directives, COVID-19 illness among patients and among staff, and implementing social distancing measures were the most reported IPC-related reasons for service disruption. Antibiotic use was reported to have increased in the early phase of the COVID-19 epidemic in South Africa and Uganda. Laboratory processing for bacterial culture and sensitivity testing were disrupted in both South Africa and Uganda by the COVID-19 pandemic, though the nature and extent of the disruption varied. Facility attendances by service delivery points declined during the COVID-19 waves.

Recommendations

Based on the findings from this study, the following recommendations are offered:

1. Overall strengthening of facility IPC programs including compliance with IPC guidelines should be encouraged through regular training and enforced by the facility IPC

coordinators. In larger facilities, consideration should be given to appointing department or ward IPC coordinators, in addition to the overall IPC facility coordinator.

2. Many facilities, particularly larger ones, had to screen, triage, and isolate large numbers of patients without additional staff resources. Plans should be made to quickly recruit and train volunteers/auxiliary personnel to assist in this process, so that the health care personnel can better manage the process and focus on the critical parts of the tasks, in addition to reducing the additional workload.
3. To facilitate screening of patients and health personnel, appropriate use of screening questionnaire together with temperature checks should be made, with use of RDT for those screening positive.
4. Protection of health care personnel from infection is a priority, especially to prevent staff shortages and absences. PPE should be made easily available and should be accompanied by appropriate training in the use, maintenance, and care of the various types of PPE. All facilities should be trained in the use of one of the standard calculators for the monitoring of PPE and other IPC resources, consumption, and supply.
5. To reduce infection risk, there should be clear, easily accessible, and available IPC and COVID-19 guidelines, including guidance on implementation of the guidelines.
6. Data and knowledge about the epidemiology of the SARS-CoV-2 virus, and COVID-19 illness manifestations evolved, leading to rapid and sometimes confusing guideline changes. This situation can be mitigated by the development of a change management strategy, where clear communication is central to the process, goals are set, teams are assembled, plans developed, executed, and supported.
7. While facilities limited patient volumes to better enable screening and to enable social distancing/avoid crowding, patients may have been hesitant to attend the facilities for fear of infection. Communication to patients and the public is central in setting expectations, including on social distancing, and in providing assurances of the risk reduction strategies that have been implemented.
8. In many facilities, implementing social distancing procedures was a challenge due to space constraints. Consideration should be given to increased use of barriers to reduce infection risk and to find additional space.
9. Laboratory systems should be strengthened to ensure that they will still be able to identify bacterial infections (secondary or co-infection) even during a pandemic caused by a virus and to identify any emerging resistance.

References

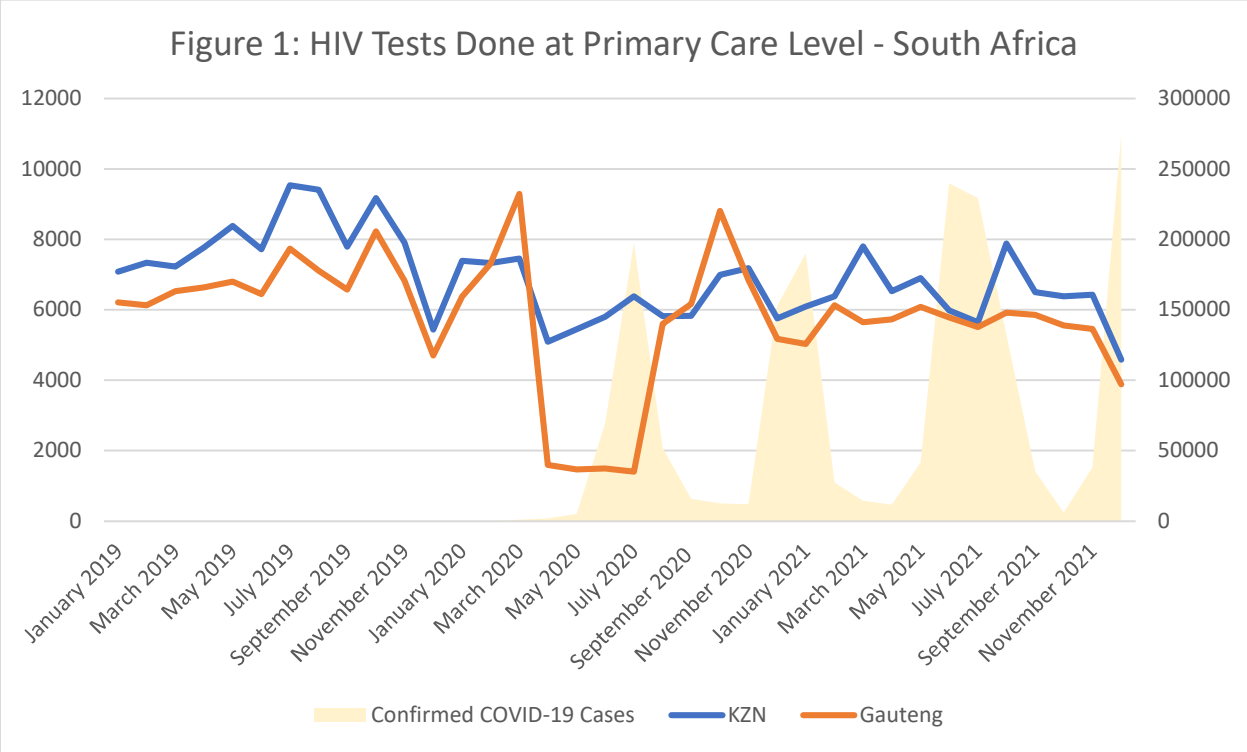
1. Pulse survey on continuity of essential health services during the COVID-19 pandemic. Interim Report. 27 August 2020. World Health Organization. (https://www.who.int/publications/i/item/WHO-2019-nCV-EHS_continuity-survey-2020.1)
2. Sara Tomczyk, Angelina Taylor, Allison Brown, Marlieke de Kraker, Tim Eckmanns, Aiman El-Saed, Impact of the COVID-19 Pandemic on Antimicrobial Resistance (AMR) Surveillance, Prevention and Control: A Global Survey. medRxiv preprint doi: https://doi.org/10.1101/2021.03.24.21253807; March 26, 2021.
3. Weekly Science Review August 8-14 2020-The indirect impacts of COVID-19 on health and essential health services in sub-Saharan Africa (https://preventepidemics.org/covid19/science/review/august-8-14-2020/)
4. Siedner MJ, Kraemer JD, Meyer MJ, et al. Access to primary healthcare during lockdown measures for COVID-19 in rural South Africa: an interrupted time series analysis. BMJ Open 2020;10:e043763. doi:10.1136/ bmjopen-2020-043763.
5. World Health Organization. COVID-19 significantly impacts health services for noncommunicable diseases. 1 June 2020. https://www.who.int/news/item/01-06-2020-covid-19-significantly-impacts-health-services-for-noncommunicable-diseases.
6. World Health Organization. Minimum requirements for infection prevention and control, Geneva 2019. https://www.who.int/infection-prevention/publications/MinReq-Manual_2019.pdf?ua=1
7. World Health Organization. Infection prevention and control during health care when coronavirus disease (COVID-19) is suspected or confirmed, 29 June 2020. WHO REFERENCE NUMBER: WHO/2019-nCoV/IPC/2020.4. https://www.who.int/publications/i/item/WHO-2019-nCoV-IPC-2020.4-
8. World Health Organization. Continuity of essential health services: Facility assessment tool. WHO REFERENCE NUMBER: WHO/2019nCoV/HCF assessment/EHS/2020.1 (https://www.who.int/publications/i/item/WHO-2019-nCoV-HCF_assessment-EHS-2020.1)
9. World Health Organization. Global pulse survey on continuity of essential health services during the COVID-19 pandemic. Round 3: Key informant findings from 129 countries, territories and areas - Quarter 4 2021, 7 February 2022, Meeting report. Global pulse survey on continuity of essential health services during the COVID-19 pandemic (who.int). (accessed December 2, 2022).
10. Our World in Data. https://ourworldindata.org/coronavirus#coronavirus-country-profiles. (accessed December 13, 2022)
11. Facente, S.N., Hunter, L.A., Packel, L.J. et al. Feasibility and effectiveness of daily temperature screening to detect COVID-19 in a prospective cohort at a large public university. BMC Public Health 21, 1ff693 (2021). https://doi.org/10.1186/s12889-021-11697-6.
12. Reddy T, Kapoor NP, Kubota S, Doubova SV, Asai D, Mariam DH, et al. Associations between the stringency of COVID-19 containment policies and health service disruptions in 10 countries. BMC Health Services Research (2023) 23:363, https://doi.org/10.1186/s12913-023-09363-1.

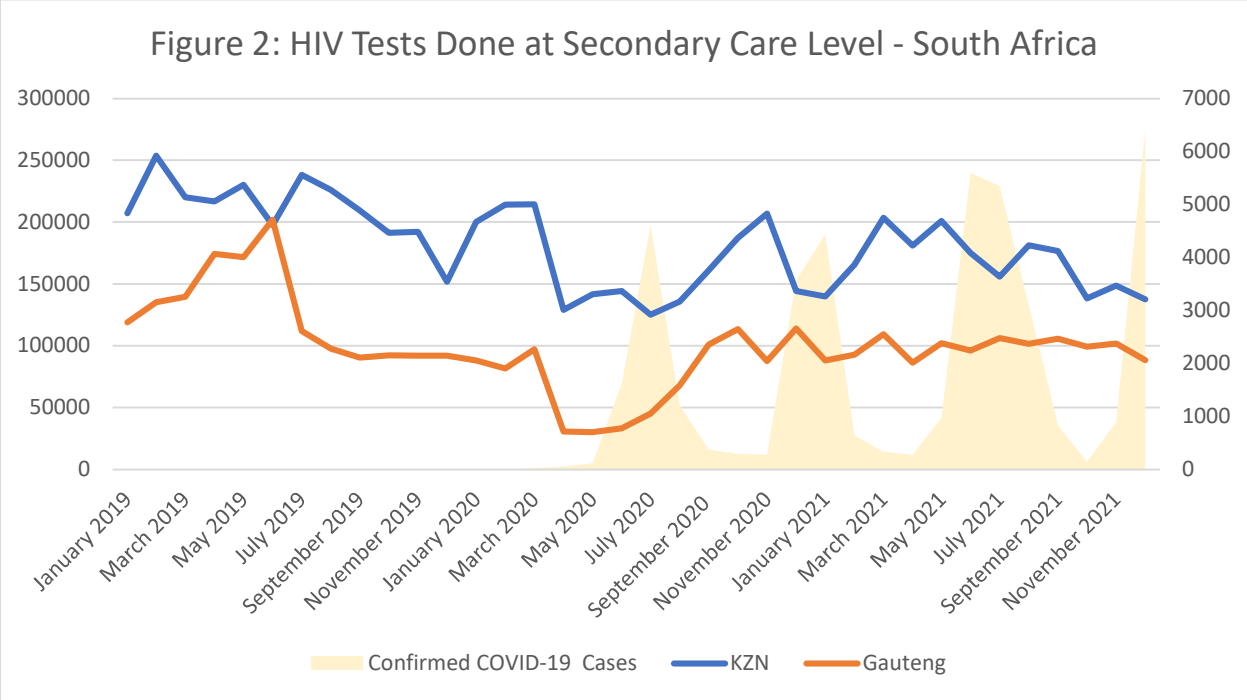
13. Nuertey BD, Ekremet K, Haidallah A-R, Mumuni K, Addai J, Attibu RIE, et al. (2021) Performance of COVID-19 associated symptoms and temperature checking as a screening tool for SARS-CoV-2 infection. PLoS ONE 16(9): e0257450. https://doi.org/10.1371/journal. pone.0257450.
14. Ahmat A, Okoroafor SC, Kazanga I*, et al.* The health workforce status in the WHO African Region: findings of a cross-sectional study. *BMJ Global Health* 2022;**7:**e008317.
15. Cong W, Poudel AN, Alhusein N, Wang H, Yao G, Lambert H. Antimicrobial use in COVID-19 patients in the first phase of the SARS-CoV-2 pandemic: rapid review and evidence synthesis. medRxiv. 2021;02:21251932.
16. Langford B, So M, Raybardhan S, Leung V, Soucy J-P, Westwood D, et al. Antibiotic prescribing in patients with COVID-19: rapid review and meta-analysis. Clin Microbiol Infect. 2021;27:520–31.
17. Nandi A, Pecetta S, Bloom DE. Global antibiotic use during the COVID-19 pandemic: analysis of pharmaceutical sales data from 71 countries, 2020–2022. eClinicalMedicine 2023;57:101848 https://doi.org/10.1016/j.eclinm.2023.
18. Moolla MS, Reddy K, Fwemba I, Nyasulu PS, Taljaard JJ, Parker A, et al. Bacterial infection, antibiotic use and COVID-19: Lessons from the intensive care unit. S Afr Med J 2021 Apr 15;111(6):575-581.
19. Langford BJ, So M, Simeonova M, Leung V, Lo J, Kan T, et al. Antimicrobial resistance in patients with COVID-19: a systematic review and meta-analysis. The Lancet Microbe 2023; 4: e179–91 January 31, 2023, https://doi.org/10.1016/S2666-5247(22)00355-X.
20. South Africa's Bold Response to the COVID-19 Pandemic. Center for Strategic and International Studies. https://www.csis.org/analysis/south-africas-bold-response-covid-19-pandemic. (Accessed March 28, 2023)
21. Federica M, Pattnaik A, Jordanwood T, Nakyanzi A, Byakika S. 2020. "Case Study: The Initial COVID-19 Response in Uganda." Washington, DC: ThinkWell and Ministry of Health Uganda. https://thinkwell.global/wp-content/uploads/2020/09/Uganda-COVID-19-Case-Study-_18-Sept-20201.pdf. (Accessed March 29, 2023)
22. World Bank. Classification of Countries by Income. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/408581467988942234/the-world-banks-classification-of-countries-by-income. (Accessed May 16, 2023)
23. Dorward J, Khubone T, Gate K, Ngobese H, Sookrajh Y, Mkhize S, et al. The impact of the COVID-19 lockdown on HIV care in 65 South African primary care clinics: an interrupted timeseries analysis. Lancet HIV 2021; 8: e158–65 https://doi.org/10.1016/S2352-3018(20)30359-3
24. Benade M, Long L, Rosen S, Meyer-Rath G, Tucker JM, Miot J. Reduction in initiations of HIV treatment in South Africa during the COVID pandemic. BMC Health Serv Res. 2022 Mar 31;22(1):428. doi: 10.1186/s12913-022-07714-y. PMID: 35361209; PMCID: PMC8970413.
25. The Global Fund to Fight AIDS, Tuberculosis and Malaria. The Impact of COVID-19 on HIV, TB and Malaria Services and Systems for Health: A snapshot from 502 health facilities across Africa and Asia.

https://www.aidsdatahub.org/sites/default/files/resource/global-fund-covid-19-2020-disruptions-impact-report-2021.pdf. (Accessed December 12, 2022).

26. Lagat H, Sharma M, Kariithi E, et al. Impact of the COVID-19 pandemic on HIV testing and assisted partner notification services, Western Kenya. AIDS Behav 2020; 24: 3010–13. 15.
27. Odinga MM, Kuria S, Muindi O, et al. HIV testing amid COVID-19: community efforts to reach men who have sex with men in three Kenyan counties. Gates Open Res 2020; 4: 117.
28. Ponticiello M, Mwanga-Amumpaire J, Tushemereirwe P, Nuwagaba G, King R, Sundararajan R. "Everything is a mess": how COVID-19 is impacting engagement with HIV testing services in rural Southwestern Uganda. AIDS Behav 2020; 24: 3006–09.
29. Abdool Karim Q, Abdool Karim SS. COVID-19 affects HIV and tuberculosis care. Science 2020; 369: 366–68.
30. Government of Uganda, Response Information Hub. https://covid19.gou.go.ug/timeline.html. (accessed December 15, 2022)
31. Elizabeth Glaser Pediatric AIDS Foundation, 2023.

Appendix 1. Graphs of Facility Attendance by Service Delivery – South Africa





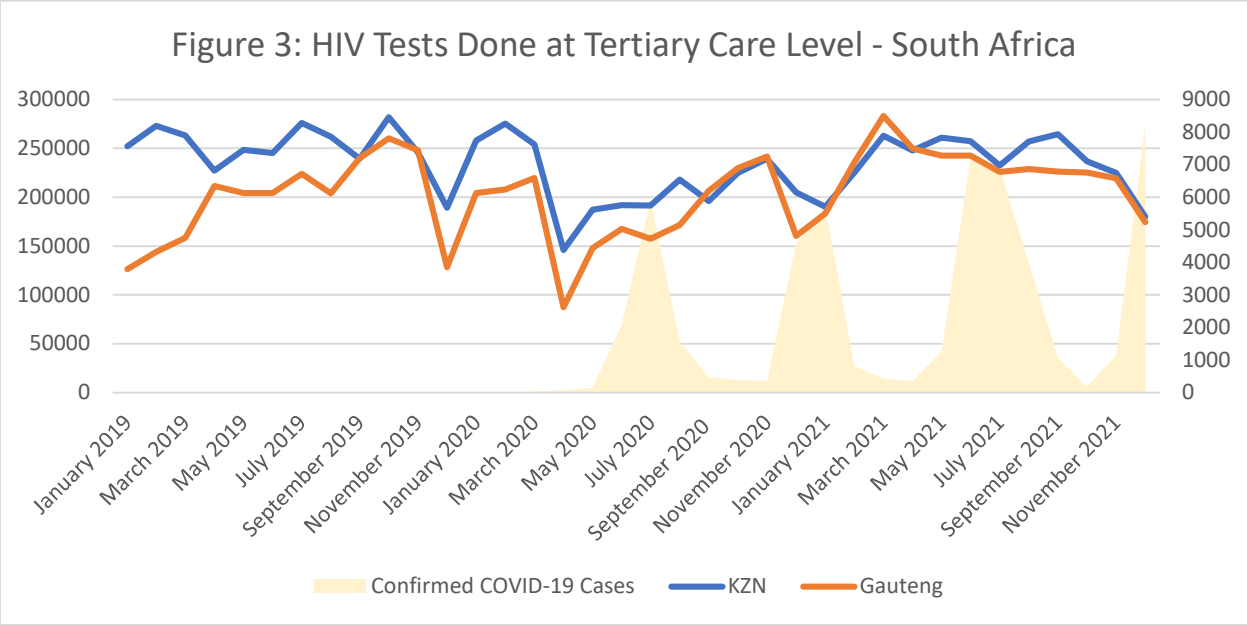


Figure 3: HIV Tests Done at Tertiary Care Level - South Africa
300000
250000
200000
150000
100000
50000
0
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
January 2019
March 2019
May 2019
July 2019
September 2019
November 2019
January 2020
March 2020
May 2020
July 2020
September 2020
November 2020
January 2021
March 2021
May 2021
July 2021
September 2021
November 2021
Confirmed COVID-19 Cases
KZN
Gauteng

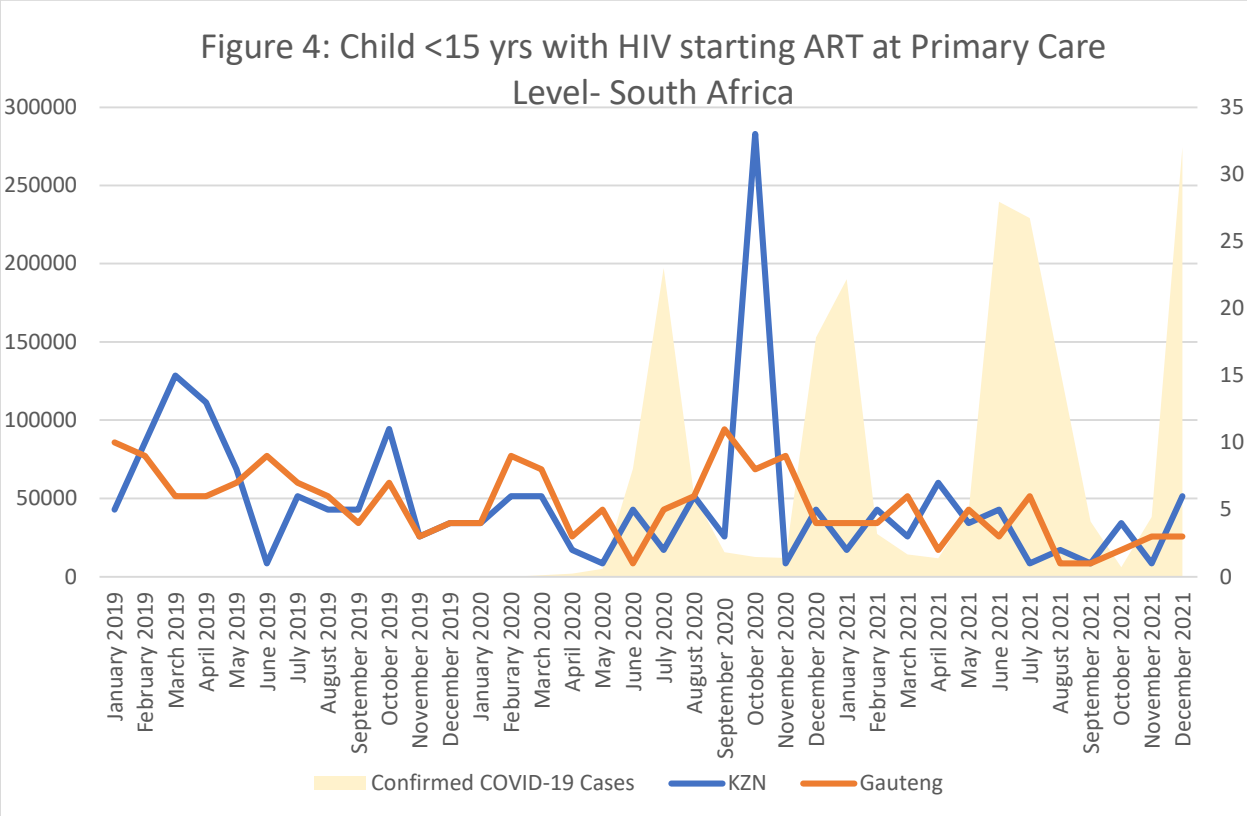


Figure 4: Child <15 yrs with HIV starting ART at Primary Care Level- South Africa
300000
250000
200000
150000
100000
50000
0
35
30
25
20
15
10
5
0
January 2019
February 2019
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
March 2021
April 2021
May 2021
June 2021
July 2021
August 2021
September 2021
October 2021
November 2021
December 2021
Confirmed COVID-19 Cases
KZN
Gauteng

Figure 5: Child <15 yrs with HIV starting ART at Secondary Care Level - South Africa

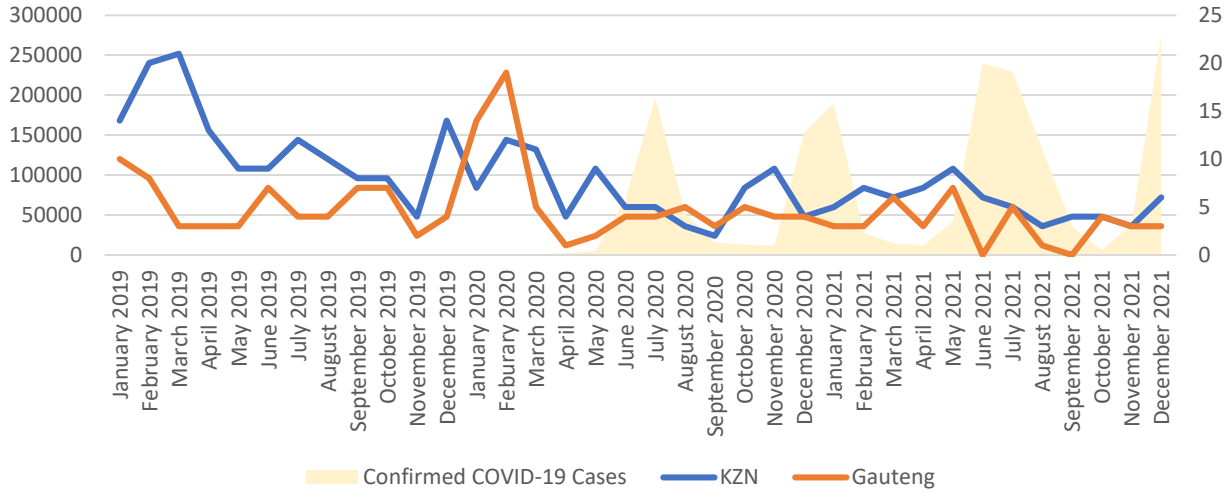


Figure 6: Child <15 with HIV starting ART at Tertiary Care Level - South Africa

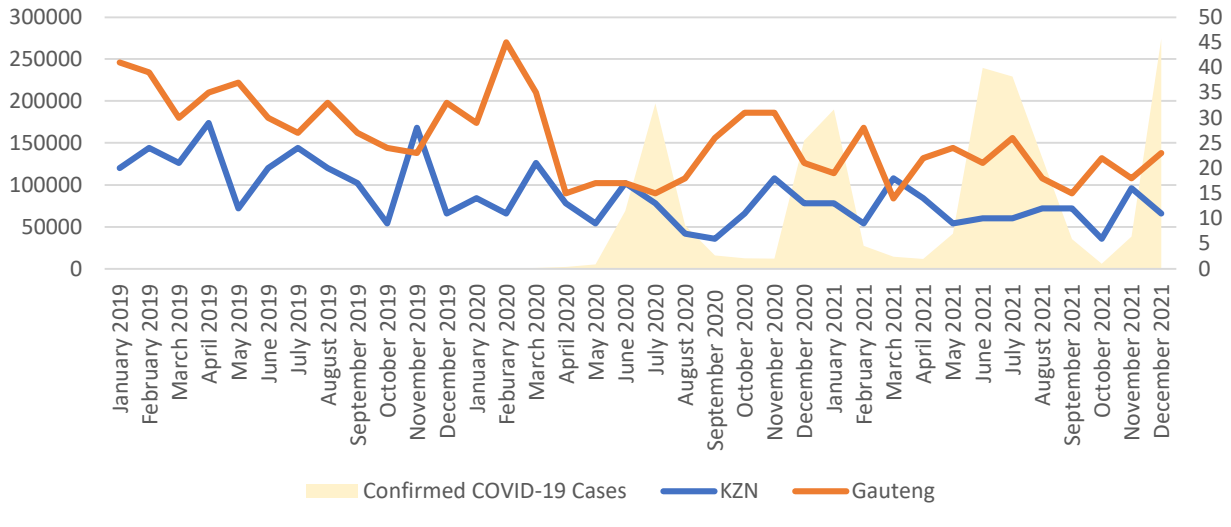


Figure 7: Adult with HIV starting ART at Primary Care Level - South Africa

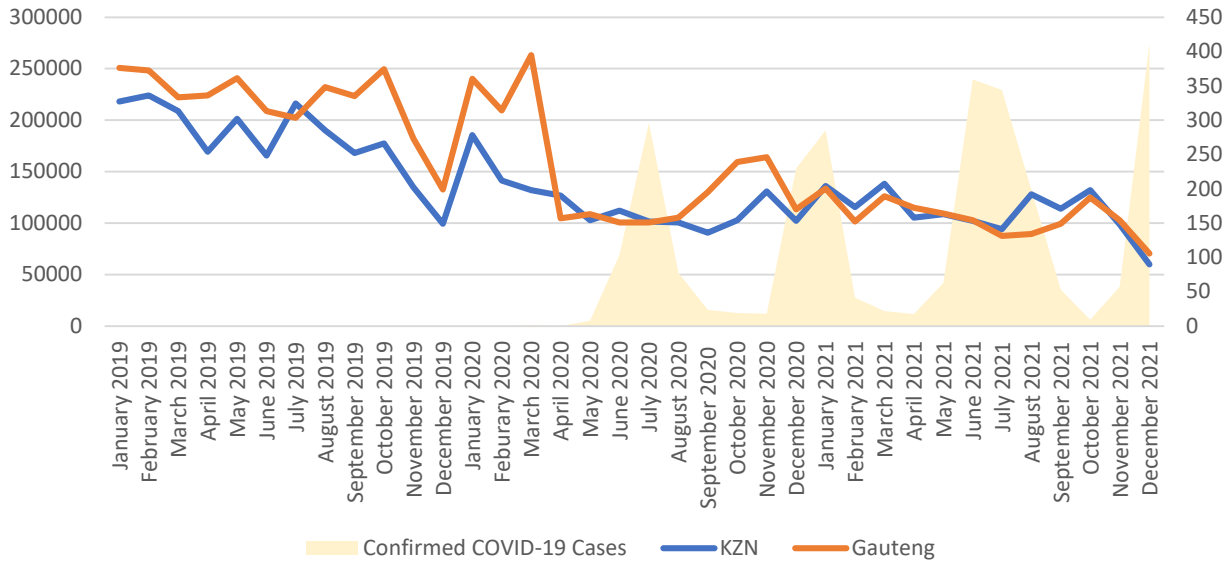


Figure 8: Adult with HIV starting ART at Secondary Care Level - South Africa

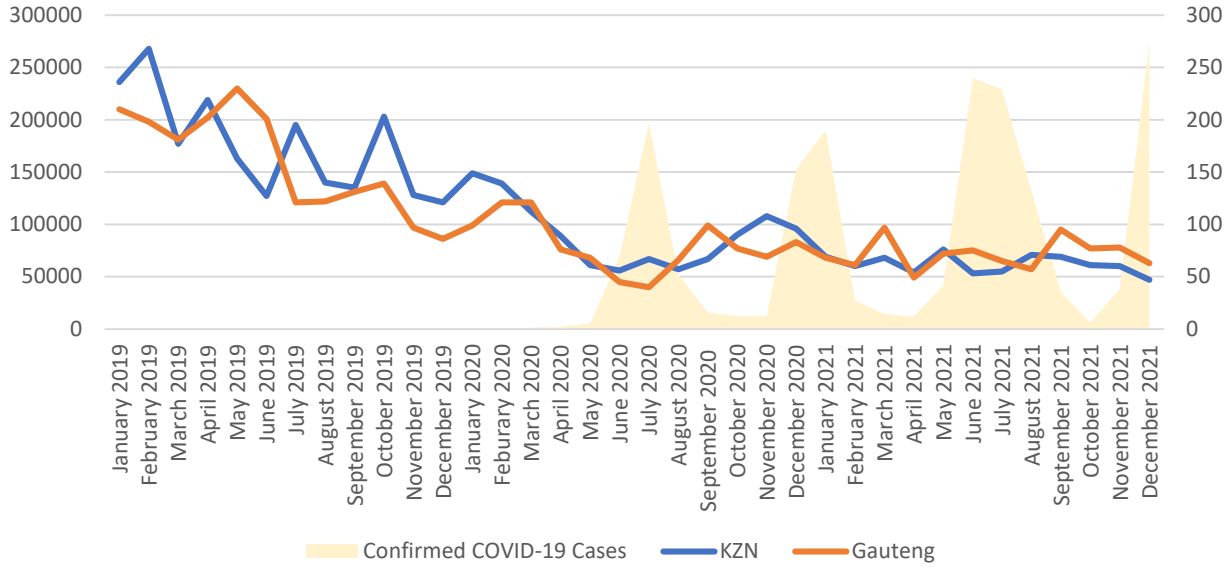


Figure 9: Adult with HIV starting ART at Tertiary Care Level - South Africa

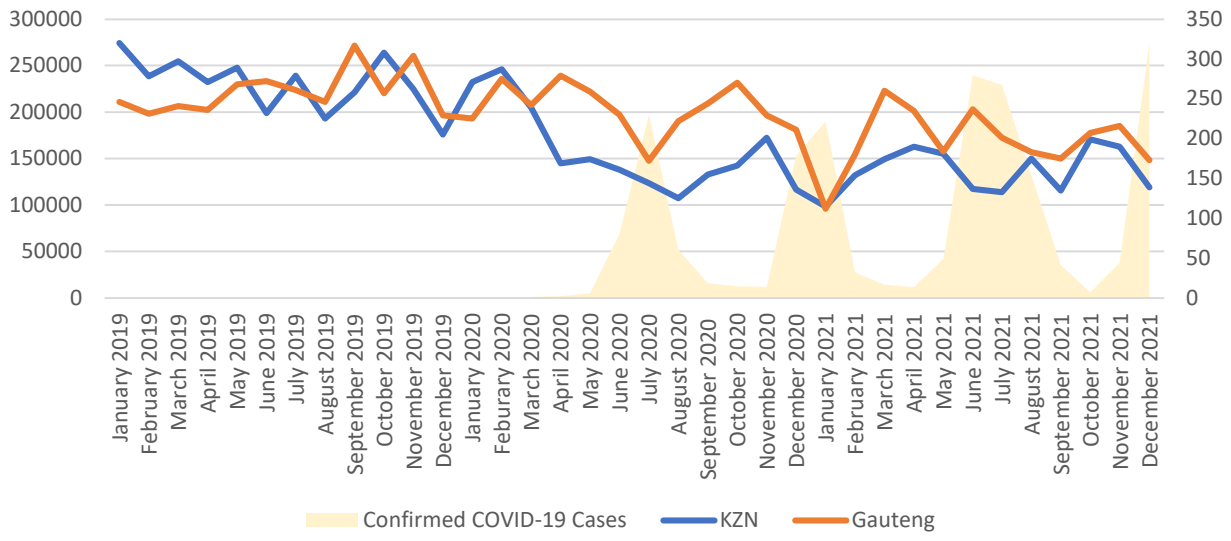


Figure 10: Child <15 yrs with HIV continuing ART at Primary Care Level - South Africa

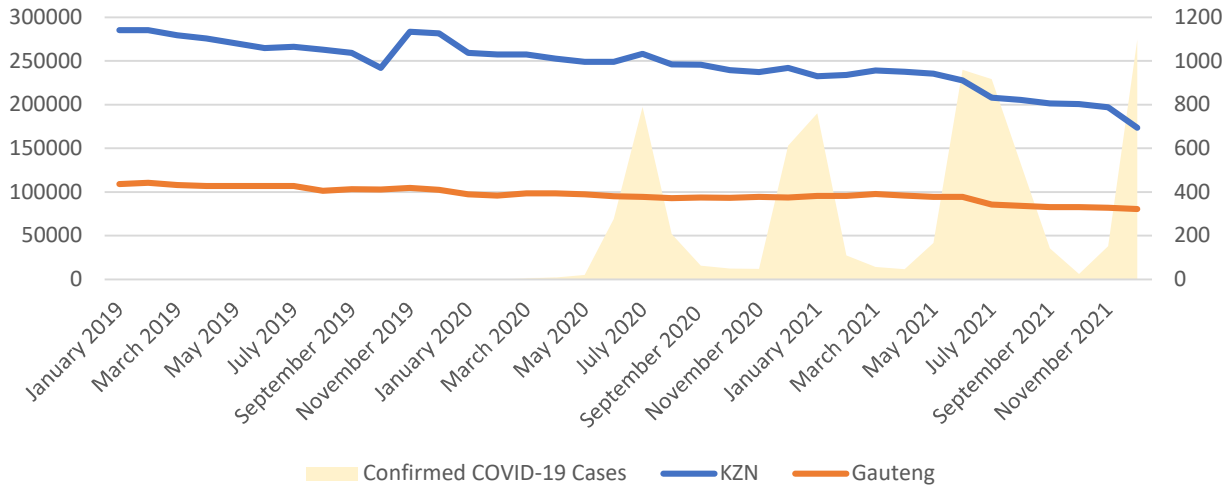


Figure 11: Child <15 yrs with HIV continuing ART at Secondary Care Level - South Africa

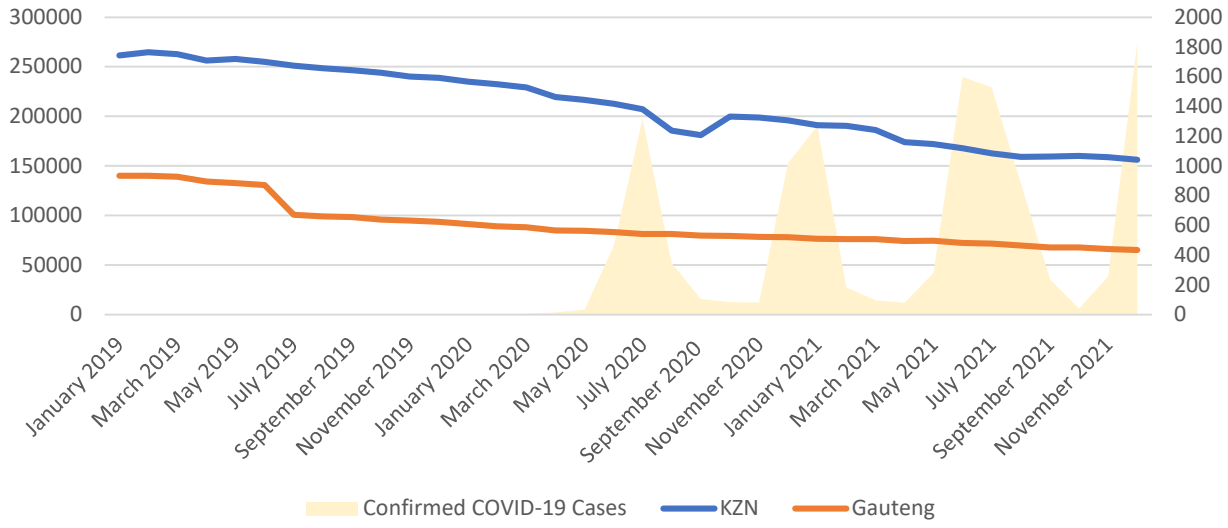


Figure 12: Child <15 yrs with HIV continuing ART at Tertiary Care Level - South Africa

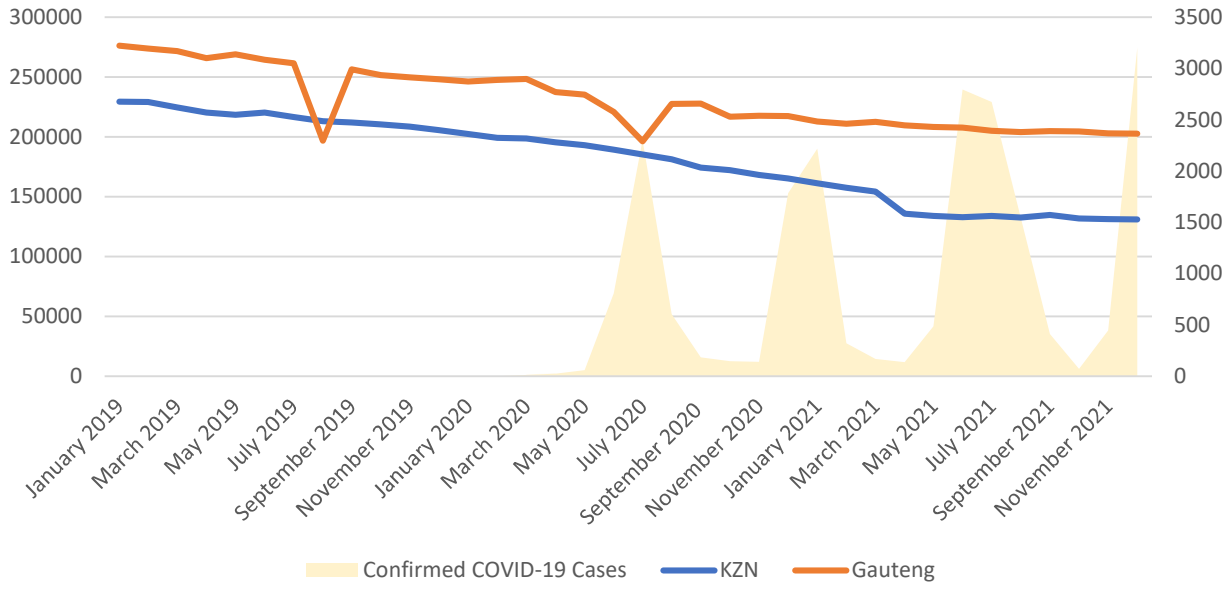


Figure 13: Adult with HIV continuing ART at Primary Care Level - South Africa

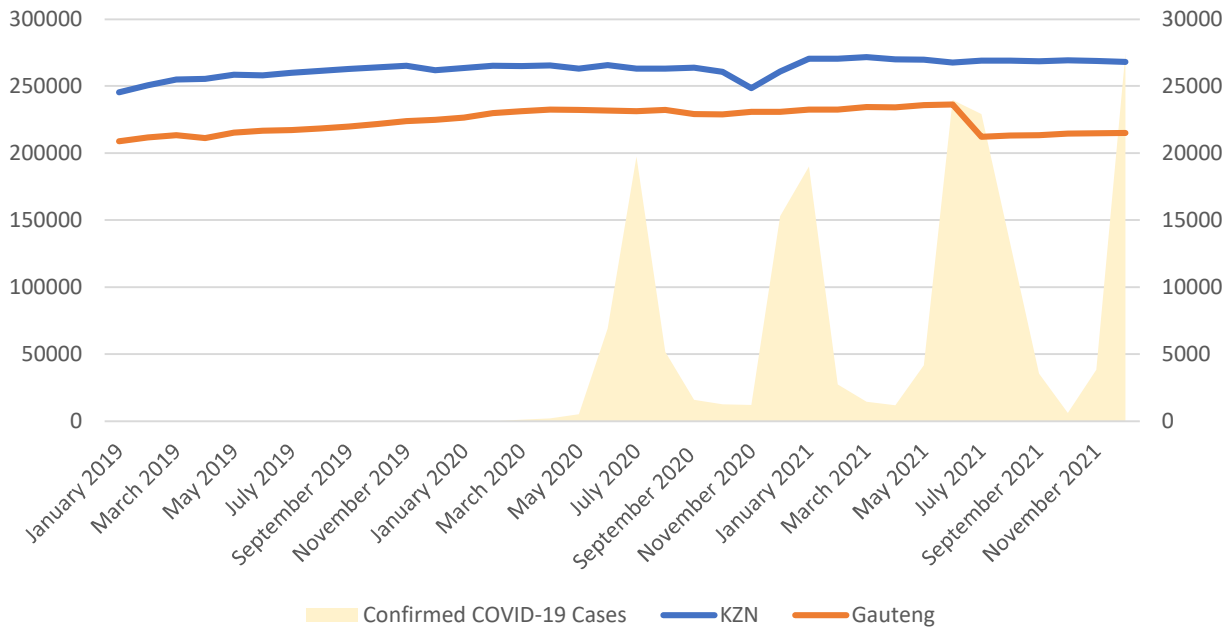
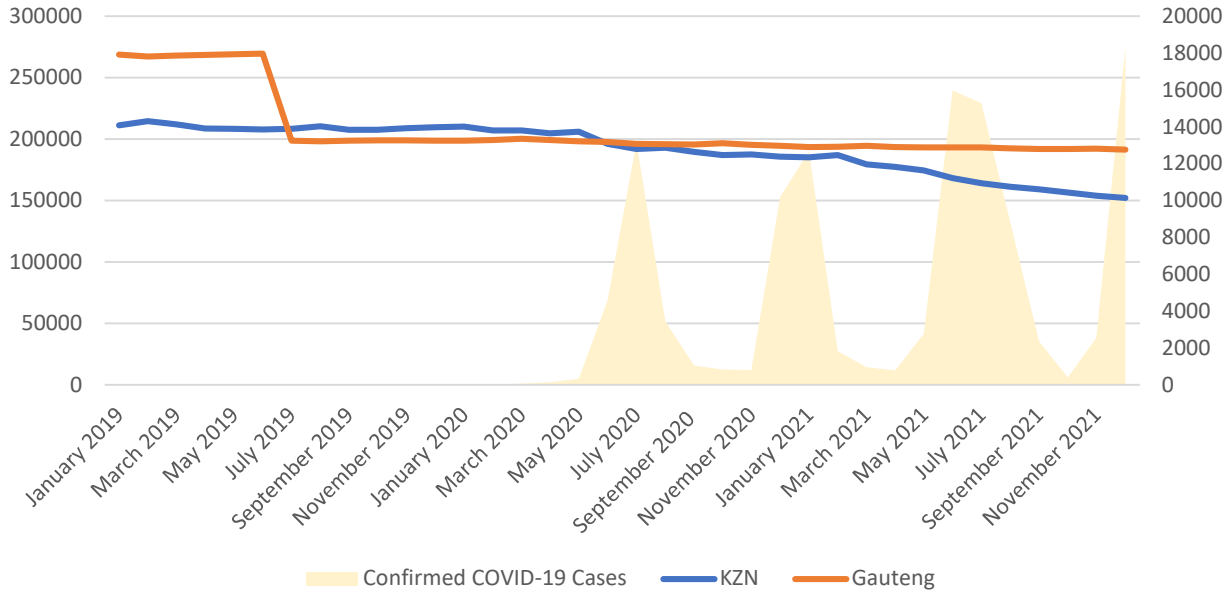


Figure 14: Adult with HIV continuing ART at Secondary Care Level - South Africa



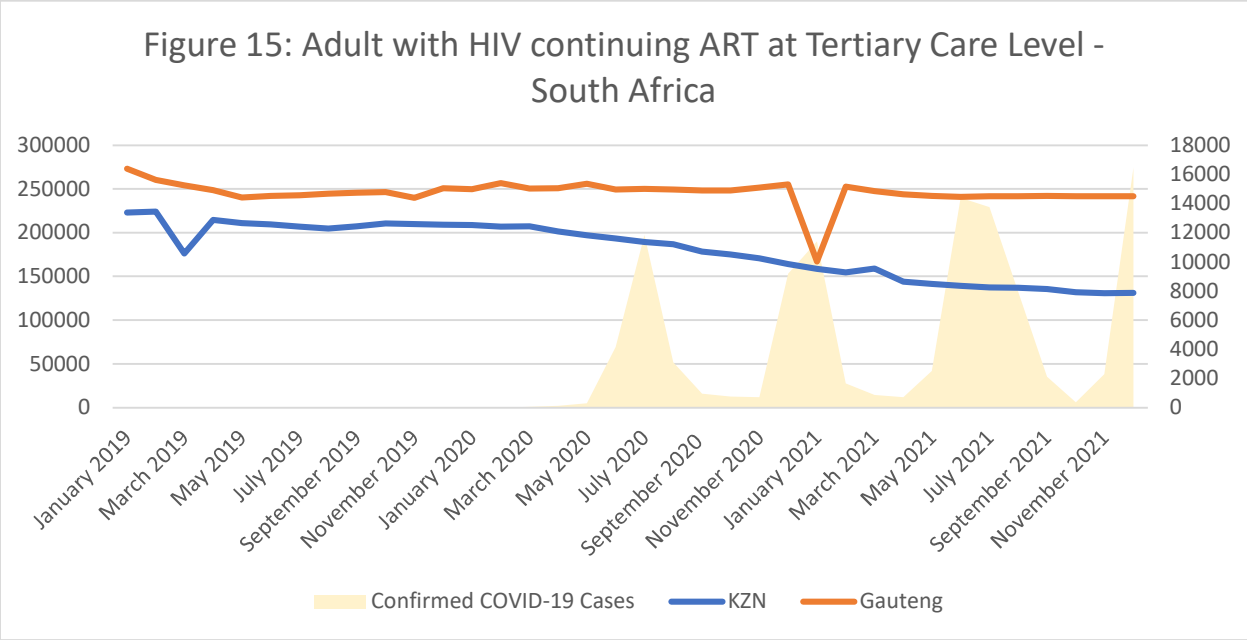


Figure 15: Adult with HIV continuing ART at Tertiary Care Level - South Africa
300000
250000
200000
150000
100000
50000
0
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
January 2019
March 2019
May 2019
July 2019
September 2019
November 2019
January 2020
March 2020
May 2020
July 2020
September 2020
November 2020
January 2021
March 2021
May 2021
July 2021
September 2021
November 2021
Confirmed COVID-19 Cases
KZN
Gauteng

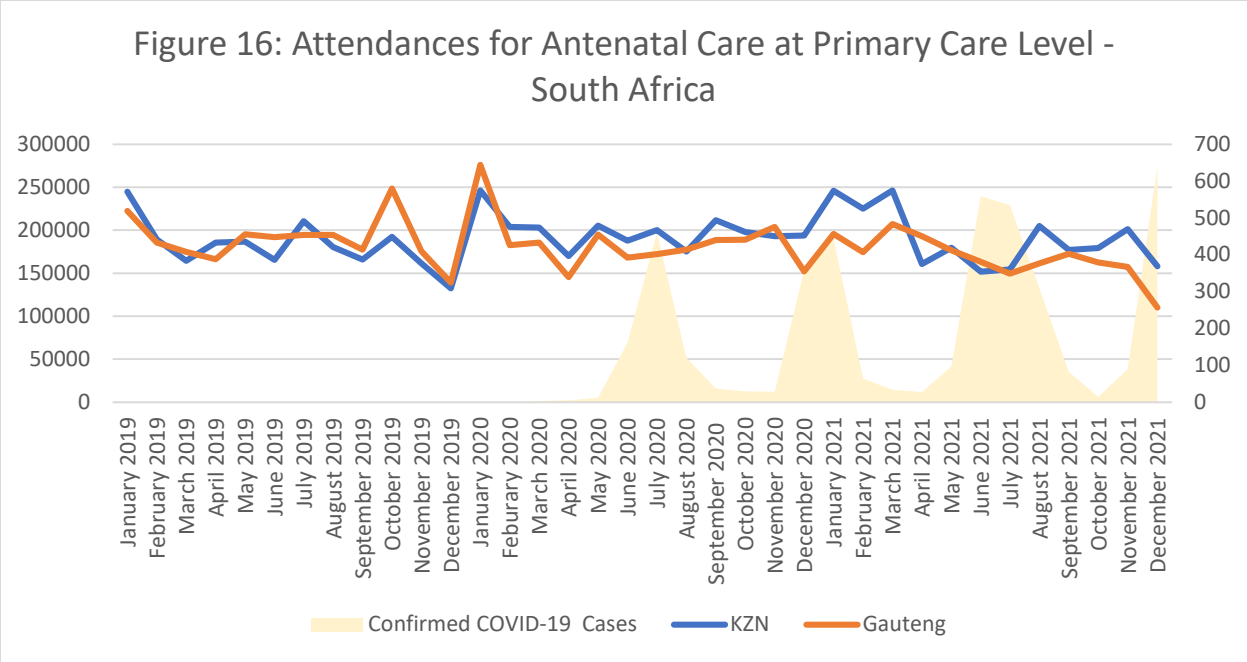


Figure 16: Attendances for Antenatal Care at Primary Care Level - South Africa
300000
250000
200000
150000
100000
50000
0
700
600
500
400
300
200
100
0
January 2019
February 2019
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
March 2021
April 2021
May 2021
June 2021
July 2021
August 2021
September 2021
October 2021
November 2021
December 2021
Confirmed COVID-19 Cases
KZN
Gauteng

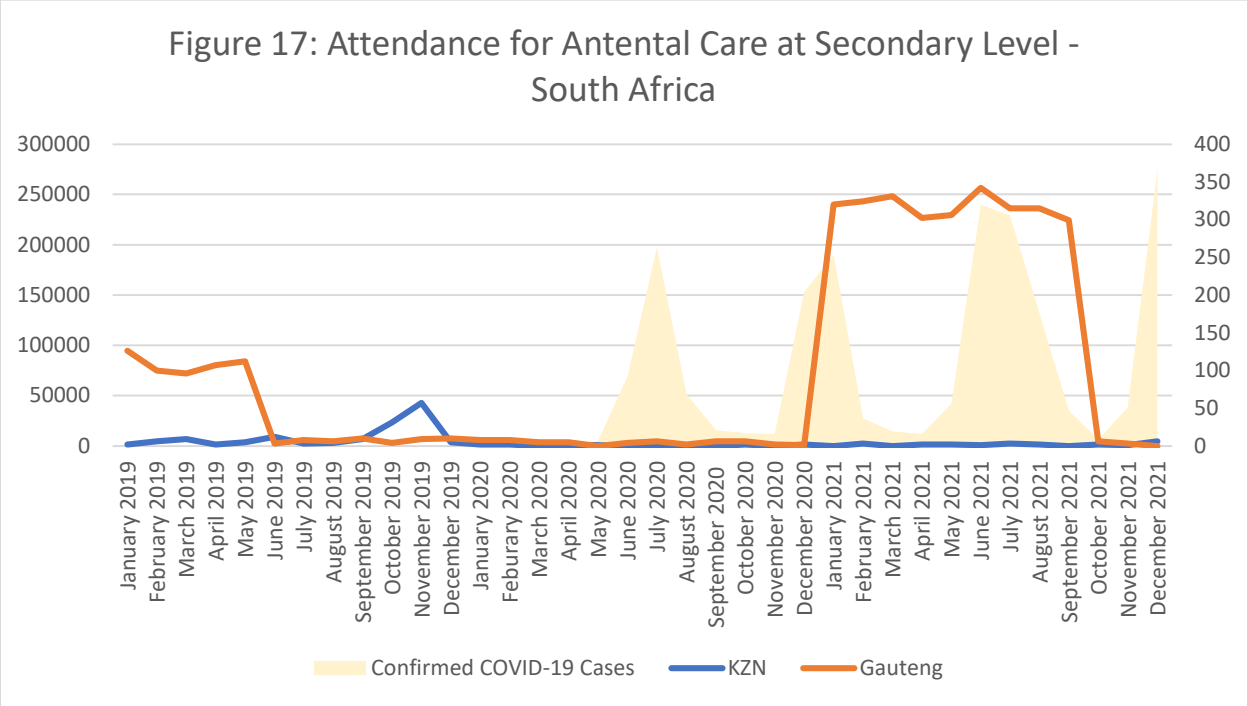


Figure 17: Attendance for Antental Care at Secondary Level - South Africa
300000
250000
200000
150000
100000
50000
0
400
350
300
250
200
150
100
50
0
January 2019
February 2019
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
March 2021
April 2021
May 2021
June 2021
July 2021
August 2021
September 2021
October 2021
November 2021
December 2021
Confirmed COVID-19 Cases
KZN
Gauteng

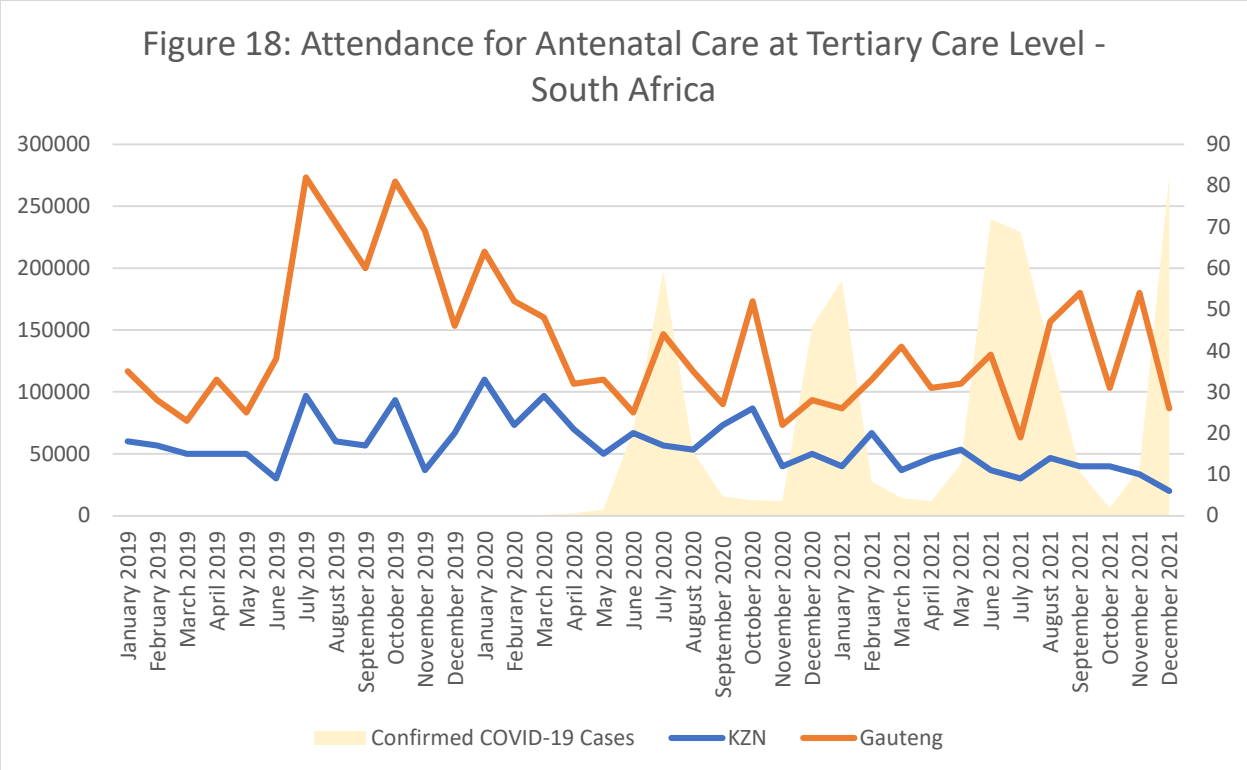


Figure 18: Attendance for Antenatal Care at Tertiary Care Level - South Africa
300000
250000
200000
150000
100000
50000
0
90
80
70
60
50
40
30
20
10
0
January 2019
February 2019
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
March 2021
April 2021
May 2021
June 2021
July 2021
August 2021
September 2021
October 2021
November 2021
December 2021
Confirmed COVID-19 Cases
KZN
Gauteng

Figure 19: Cervical Cancer screening attendances at Primary Care Level - South Africa

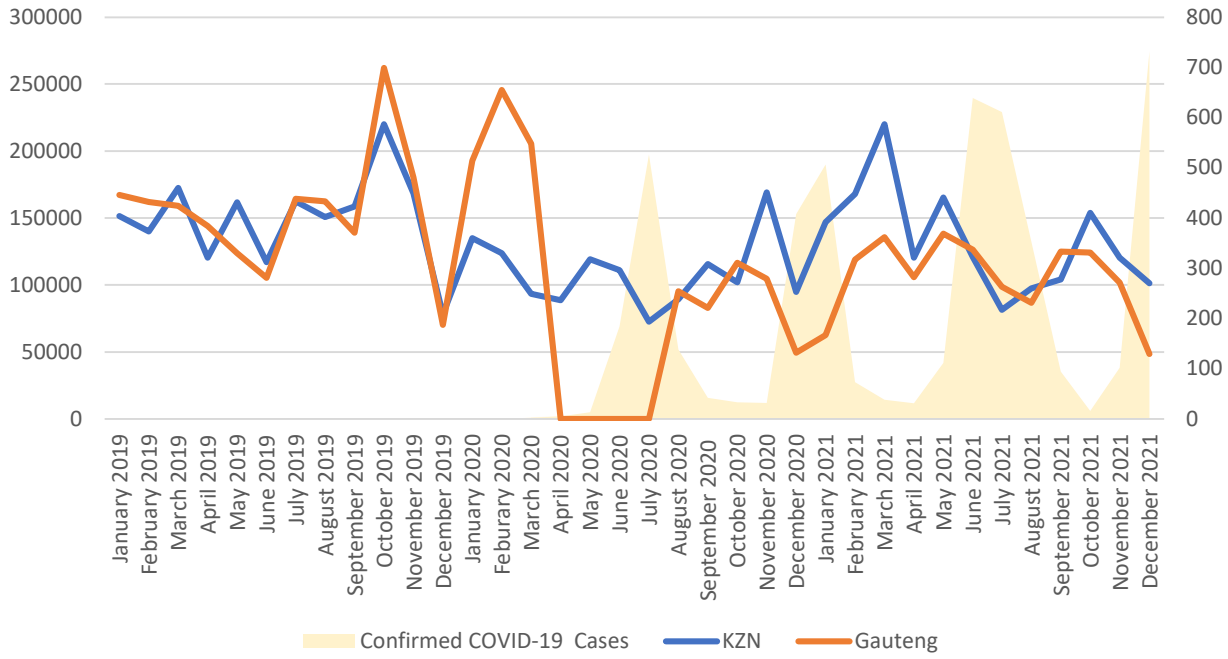


Figure 20: Cervical Cancer screening attendances at Secondary Care Level - South Africa

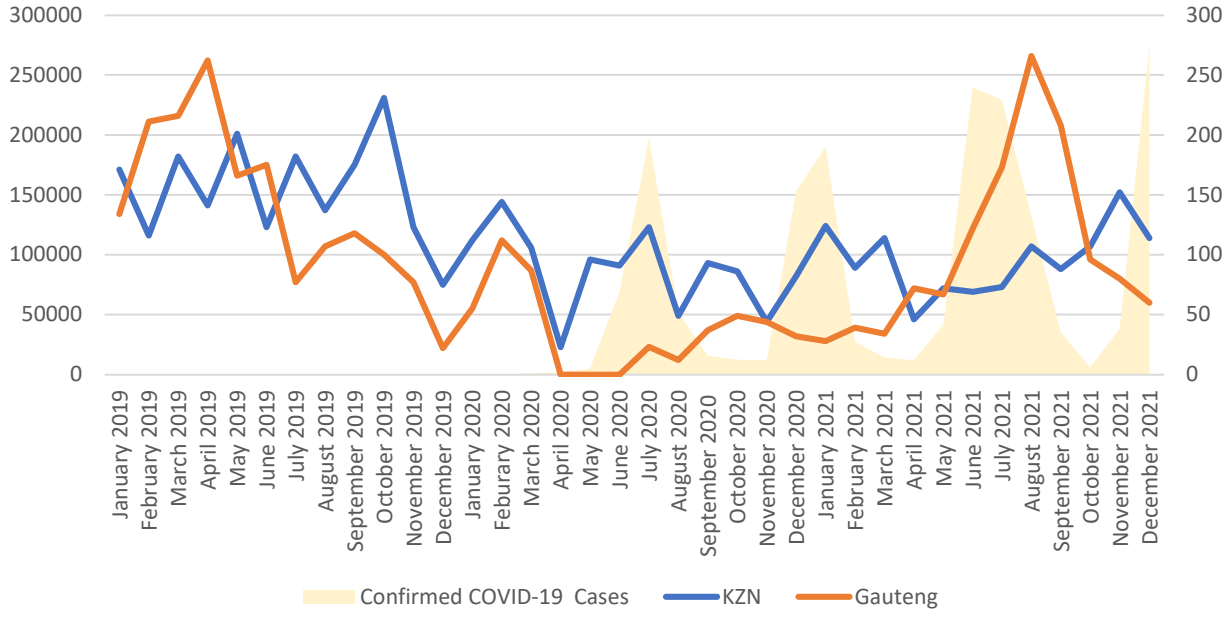


Figure 21: Cervical Cancer screening attendances at Tertiary Care Level - South Africa

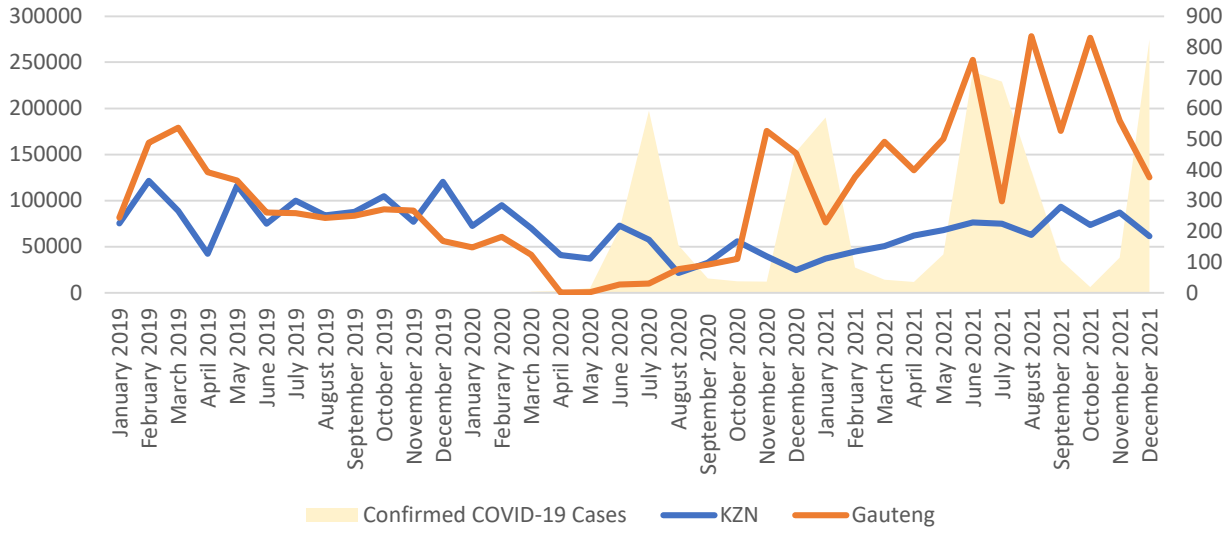


Figure 22: Numbers screened for diabetes at Primary Care Level - South Africa

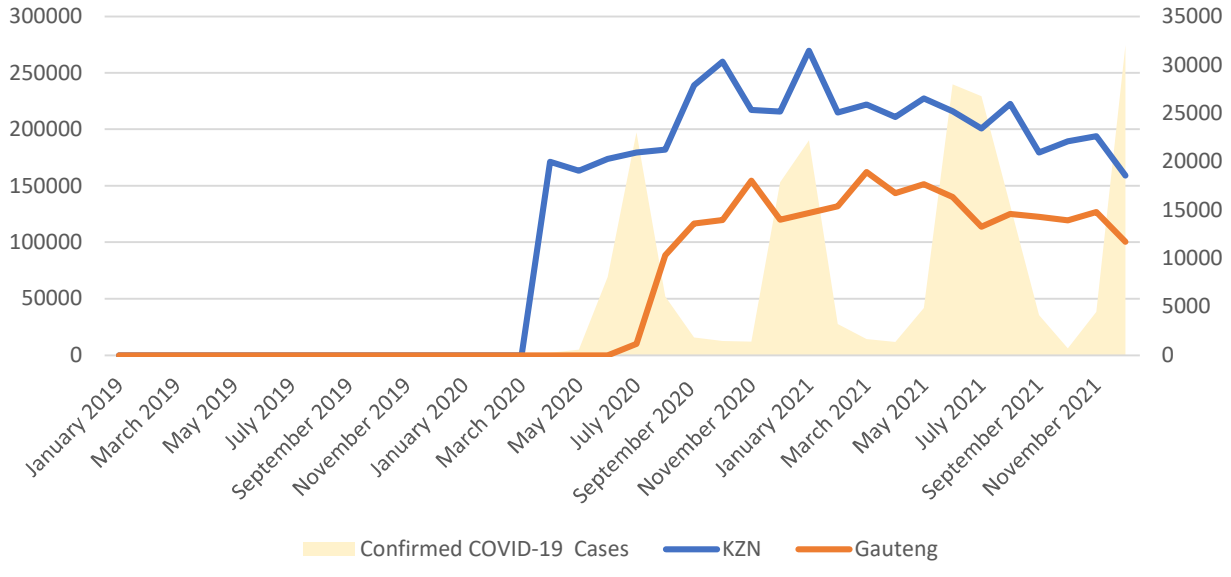


Figure 23: Numbers screened for diabetes at Secondary Care Level - South Africa

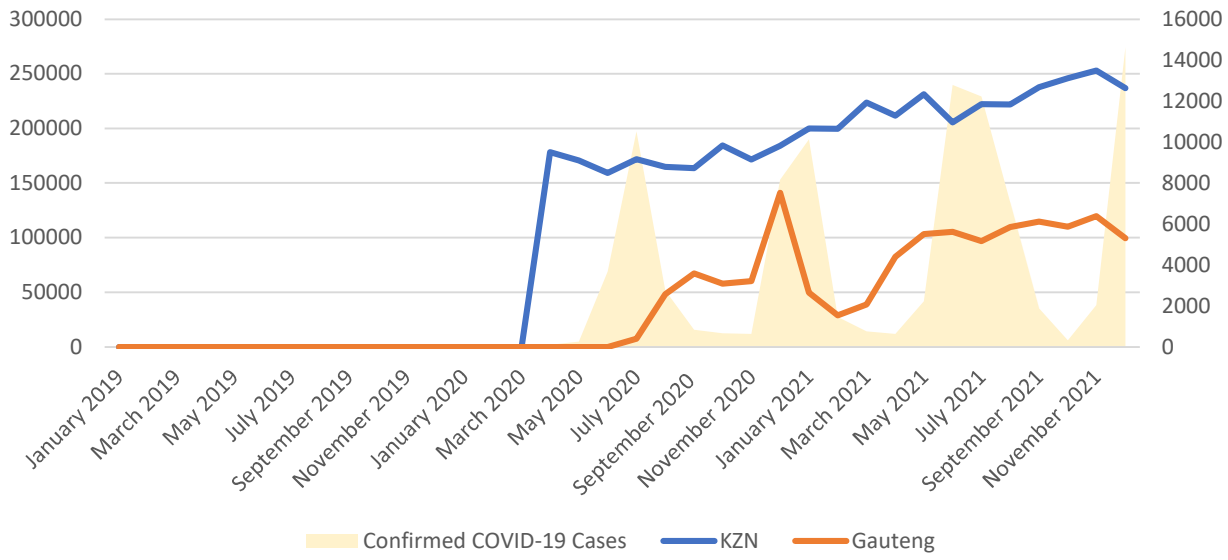


Figure 24: Numbers screened for diabetes at Tertiary Care Level - South Africa

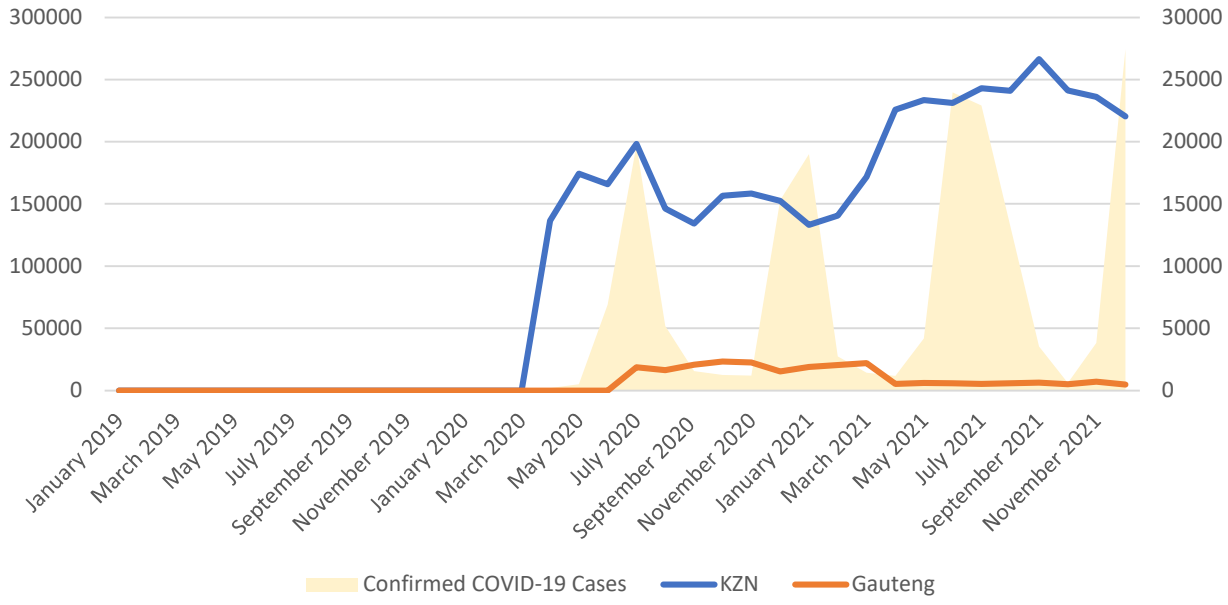


Figure 25: Numbers screening for TB at Primary Care Level - South Africa

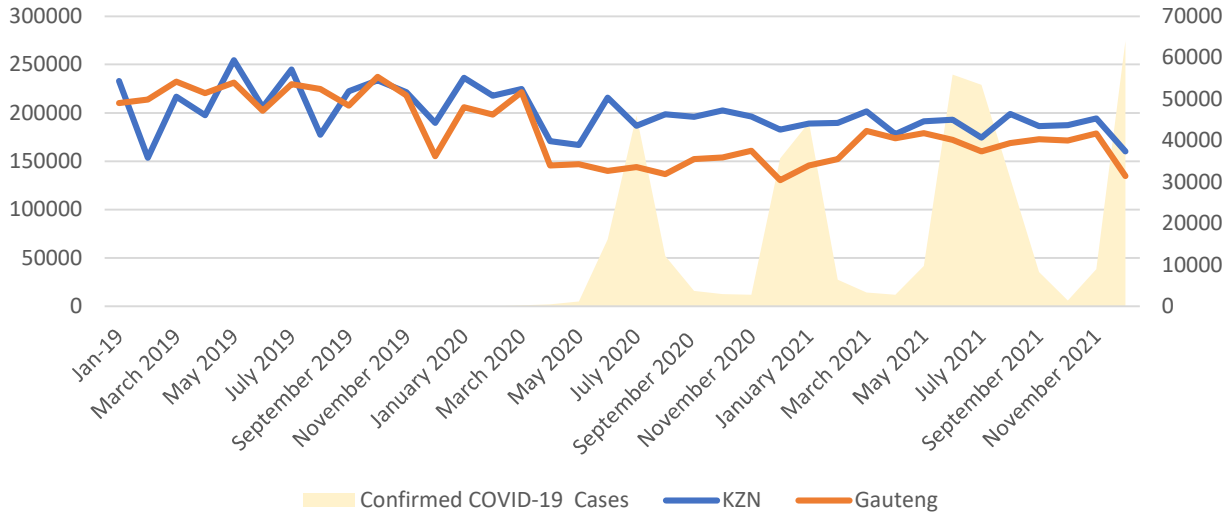
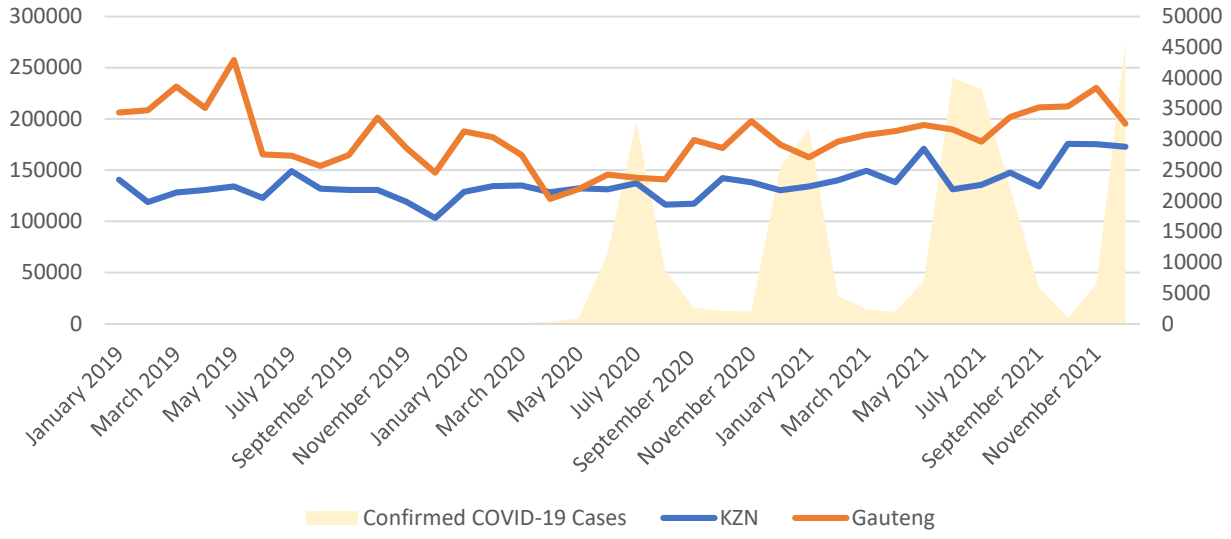


Figure 26: Numbers screened for TB at Secondary Care Level - South Africa



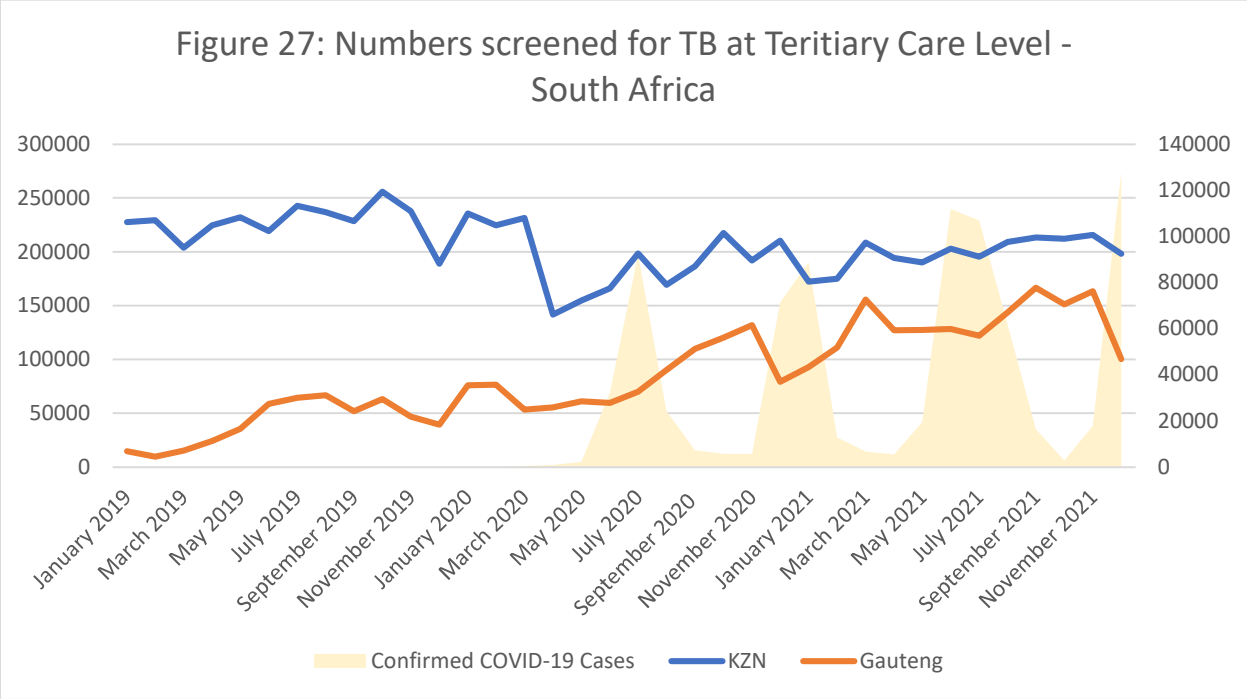
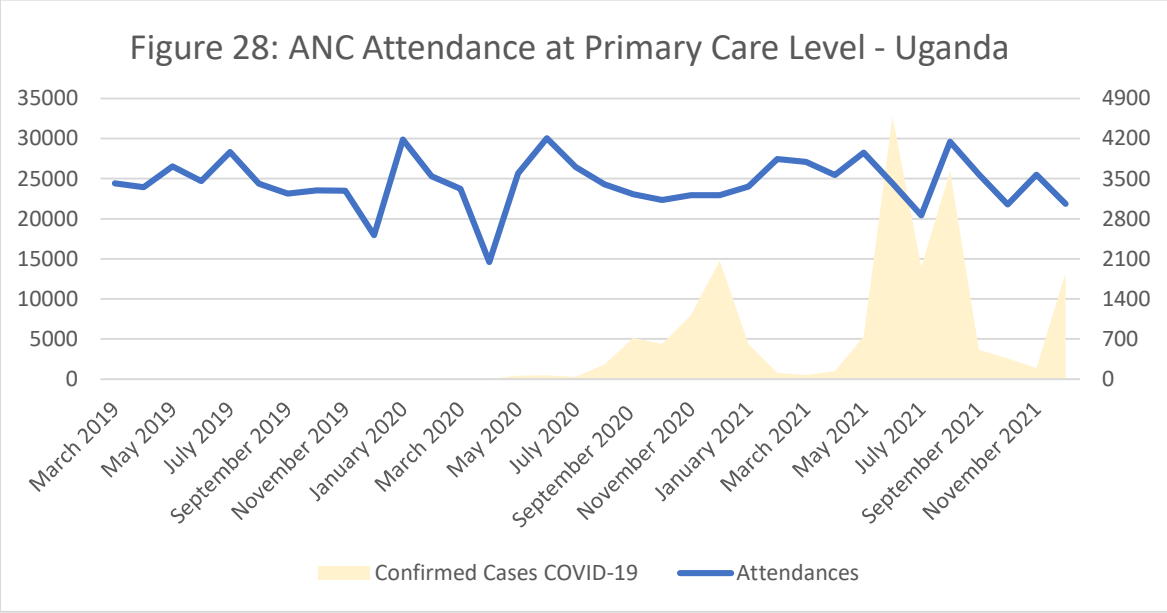
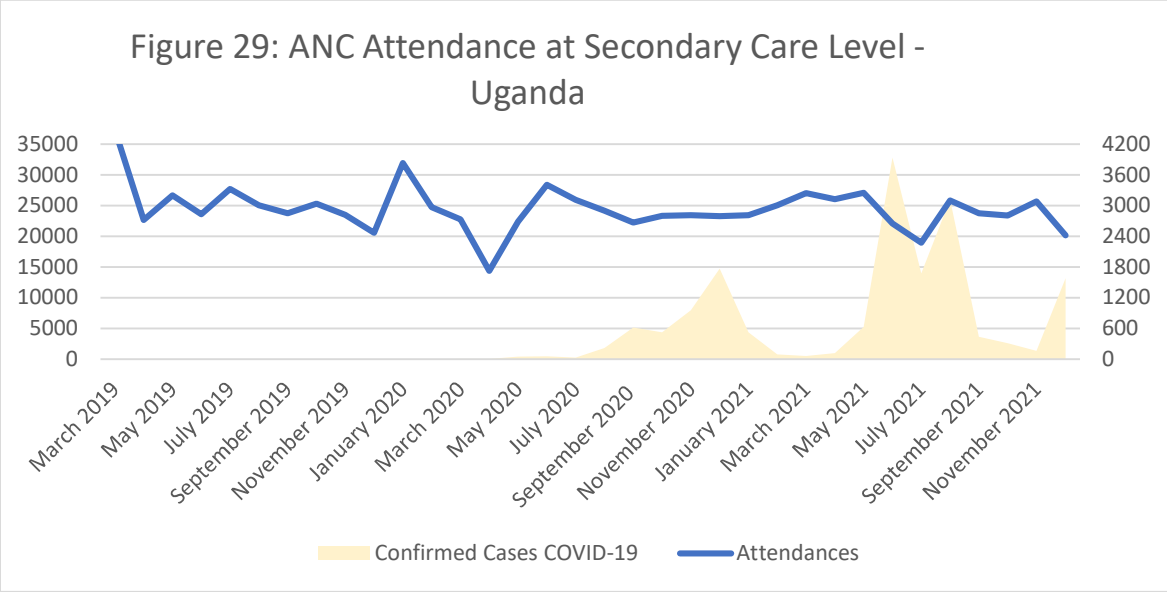


Figure 27: Numbers screened for TB at Teritiary Care Level - South Africa
300000
250000
200000
150000
100000
50000
0
140000
120000
100000
80000
60000
40000
20000
0
January 2019
March 2019
May 2019
July 2019
September 2019
November 2019
January 2020
March 2020
May 2020
July 2020
September 2020
November 2020
January 2021
March 2021
May 2021
July 2021
September 2021
November 2021
Confirmed COVID-19 Cases
KZN
Gauteng

Appendix 2. Graphs of Facility Attendance by Service Delivery – Uganda





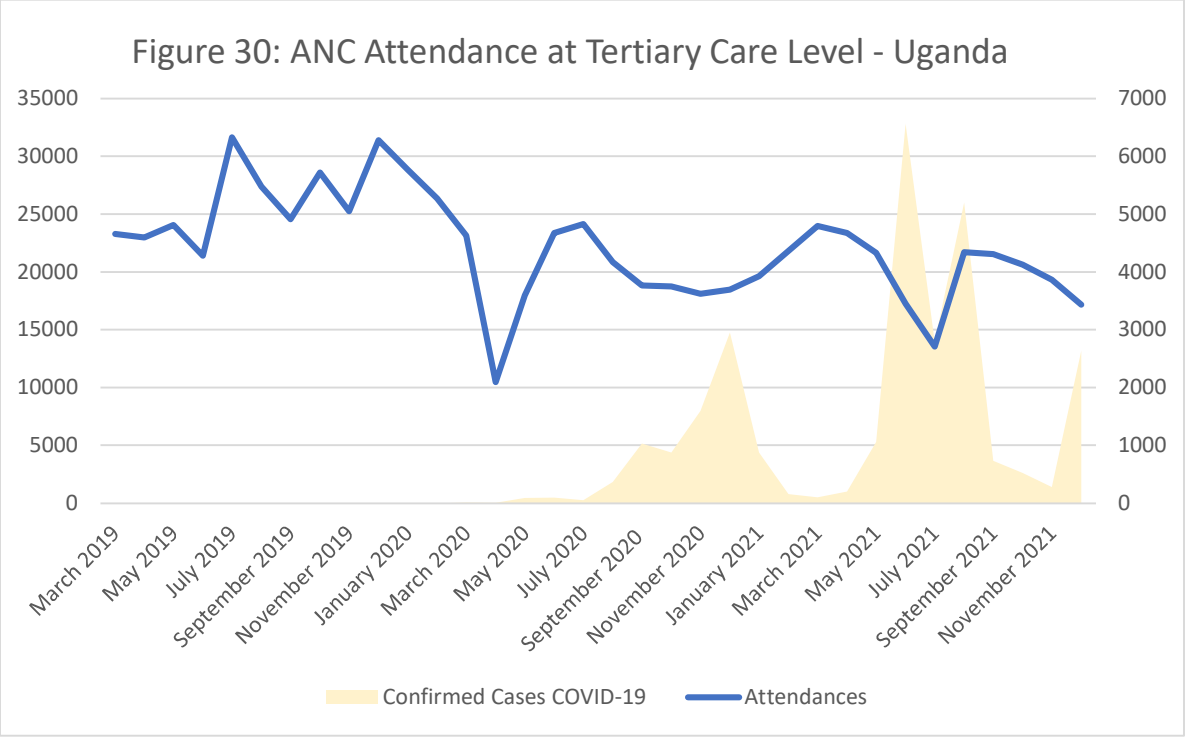


Figure 30: ANC Attendance at Tertiary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
7000
6000
5000
4000
3000
2000
1000
0
March 2019
May 2019
July 2019
September 2019
November 2019
January 2020
March 2020
May 2020
July 2020
September 2020
November 2020
January 2021
March 2021
May 2021
July 2021
September 2021
November 2021
Confirmed Cases COVID-19
Attendances

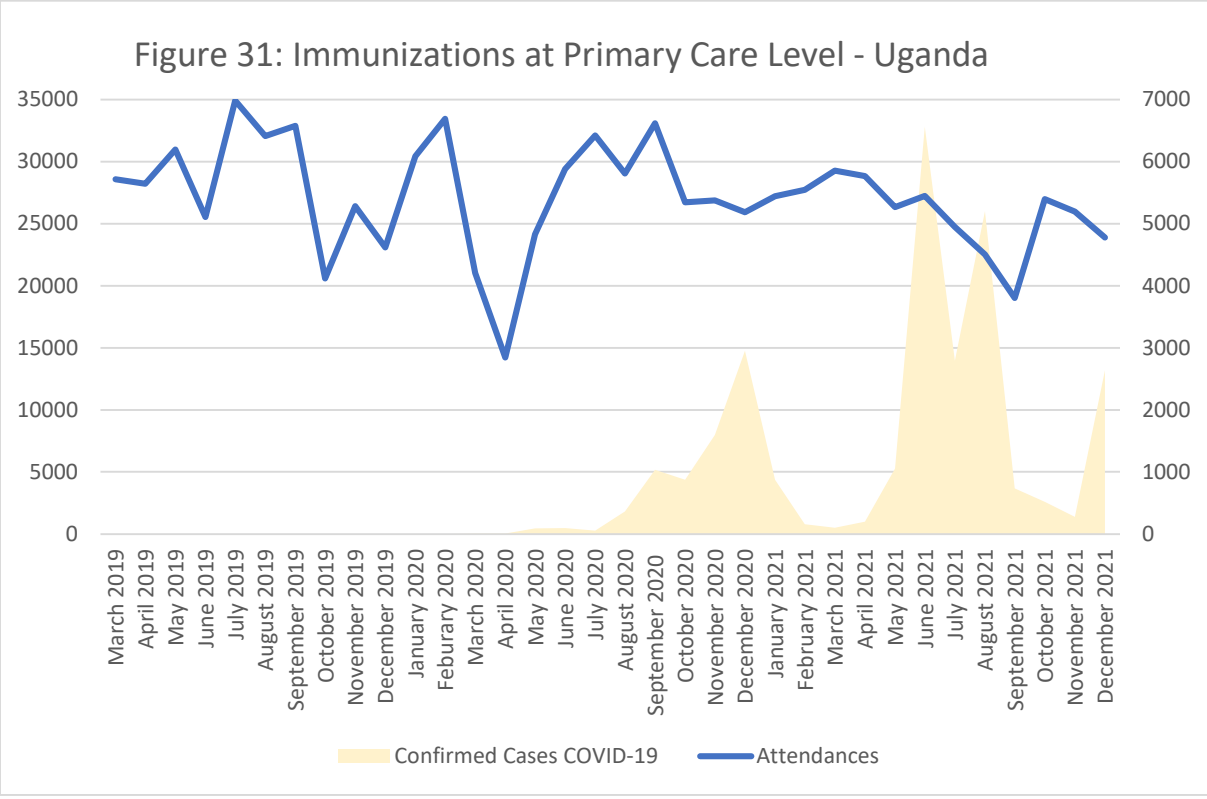


Figure 31: Immunizations at Primary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
7000
6000
5000
4000
3000
2000
1000
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
March 2021
April 2021
May 2021
June 2021
July 2021
August 2021
September 2021
October 2021
November 2021
December 2021
Confirmed Cases COVID-19
Attendances

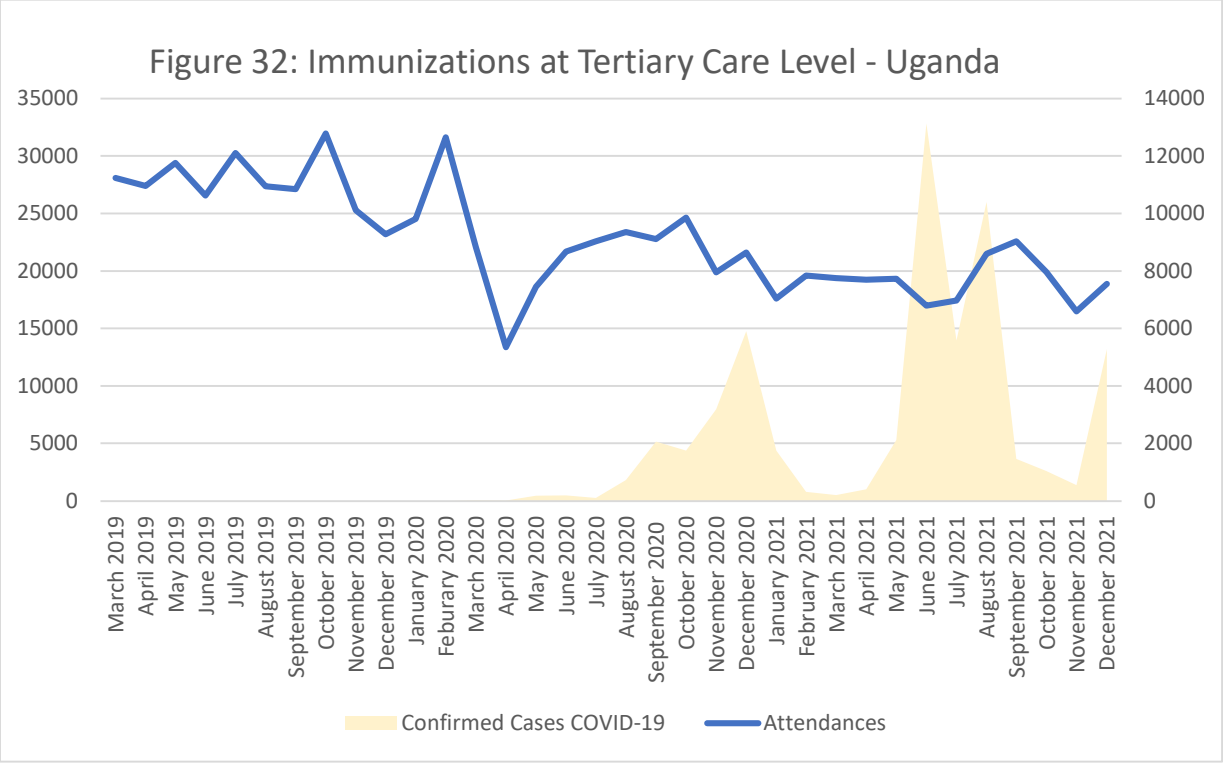


Figure 32: Immunizations at Tertiary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
14000
12000
10000
8000
6000
4000
2000
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
March 2021
April 2021
May 2021
June 2021
July 2021
August 2021
September 2021
October 2021
November 2021
December 2021
Confirmed Cases COVID-19
Attendances

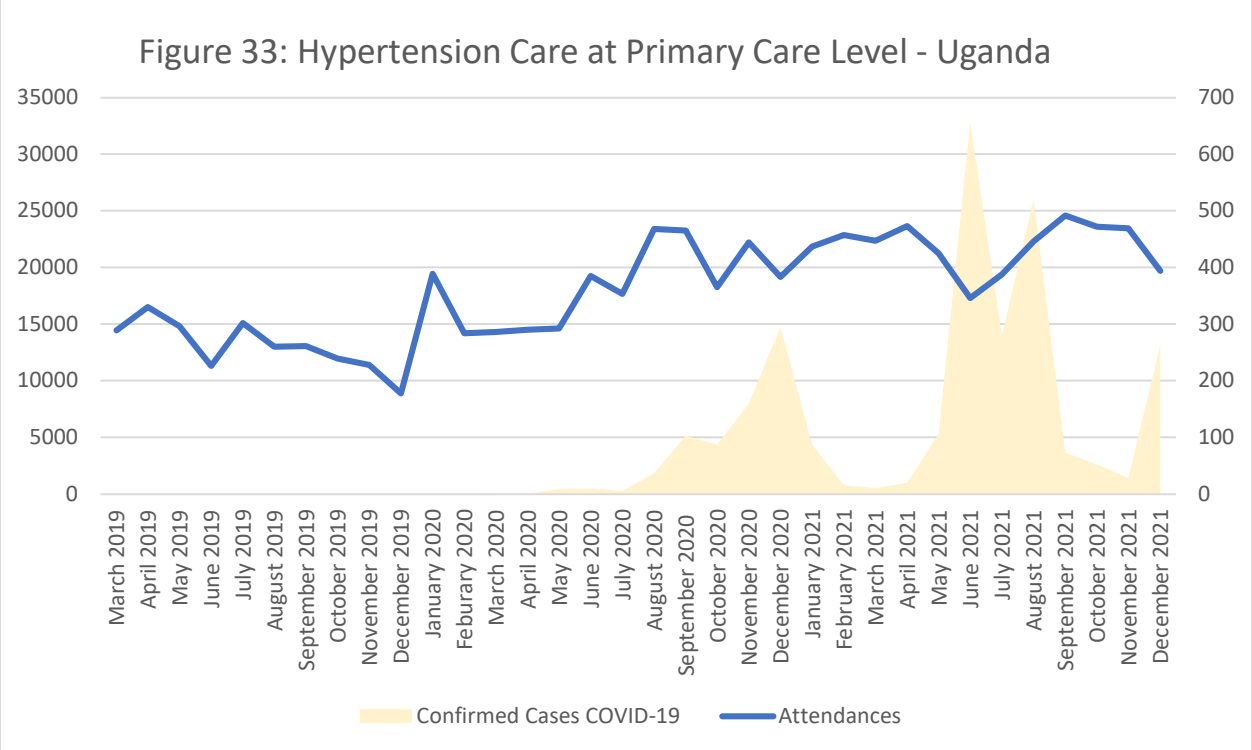


Figure 33: Hypertension Care at Primary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
700
600
500
400
300
200
100
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
March 2021
April 2021
May 2021
June 2021
July 2021
August 2021
September 2021
October 2021
November 2021
December 2021
Confirmed Cases COVID-19
Attendances

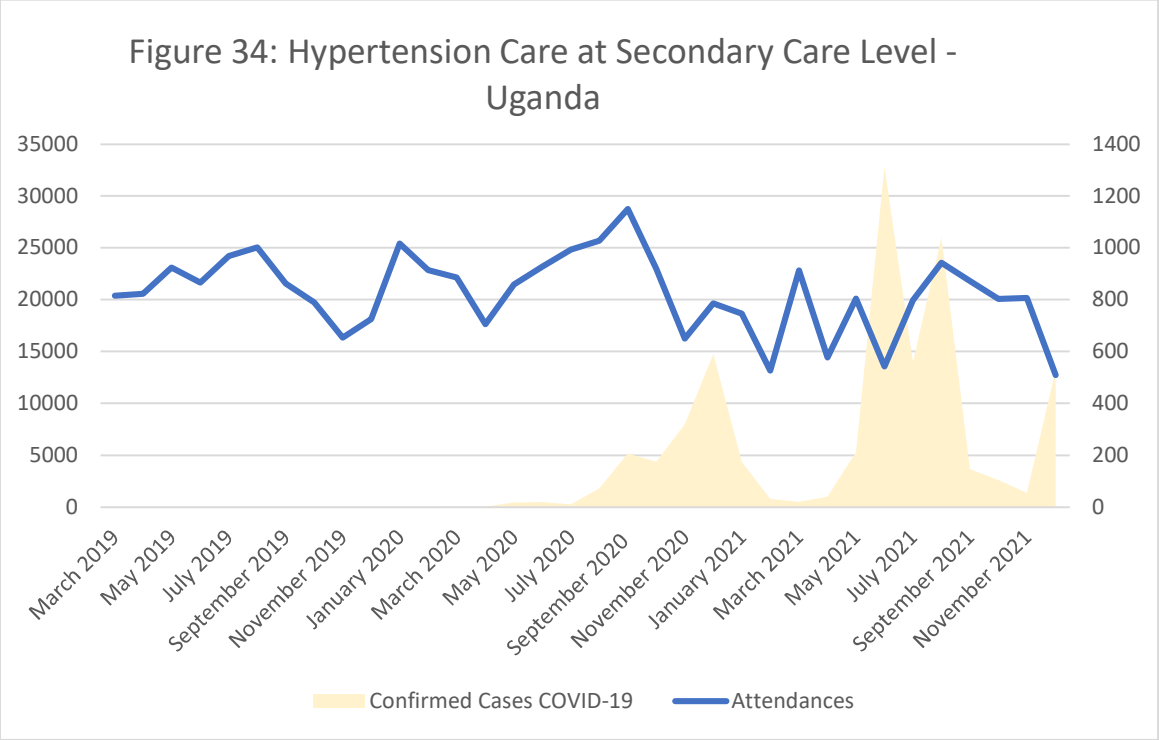


Figure 34: Hypertension Care at Secondary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
1400
1200
1000
800
600
400
200
0
March 2019
May 2019
July 2019
September 2019
November 2019
January 2020
March 2020
May 2020
July 2020
September 2020
November 2020
January 2021
March 2021
May 2021
July 2021
September 2021
November 2021
Confirmed Cases COVID-19
Attendances

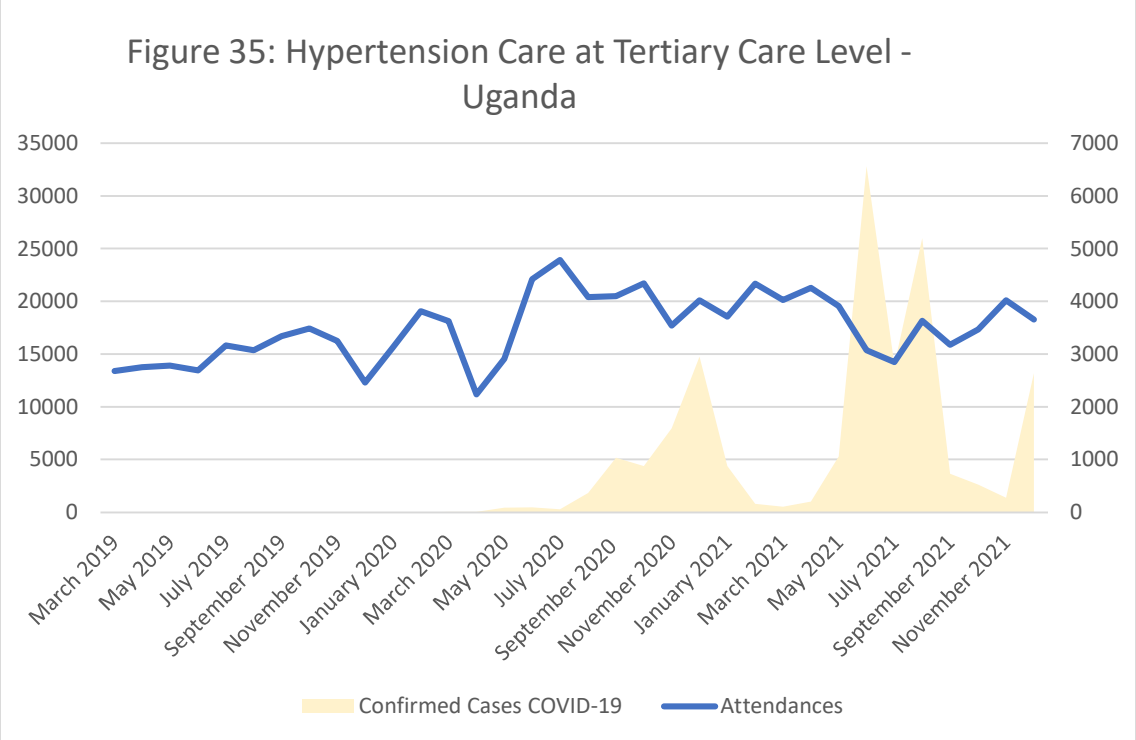


Figure 35: Hypertension Care at Tertiary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
7000
6000
5000
4000
3000
2000
1000
0
March 2019
May 2019
July 2019
September 2019
November 2019
January 2020
March 2020
May 2020
July 2020
September 2020
November 2020
January 2021
March 2021
May 2021
July 2021
September 2021
November 2021
Confirmed Cases COVID-19
Attendances

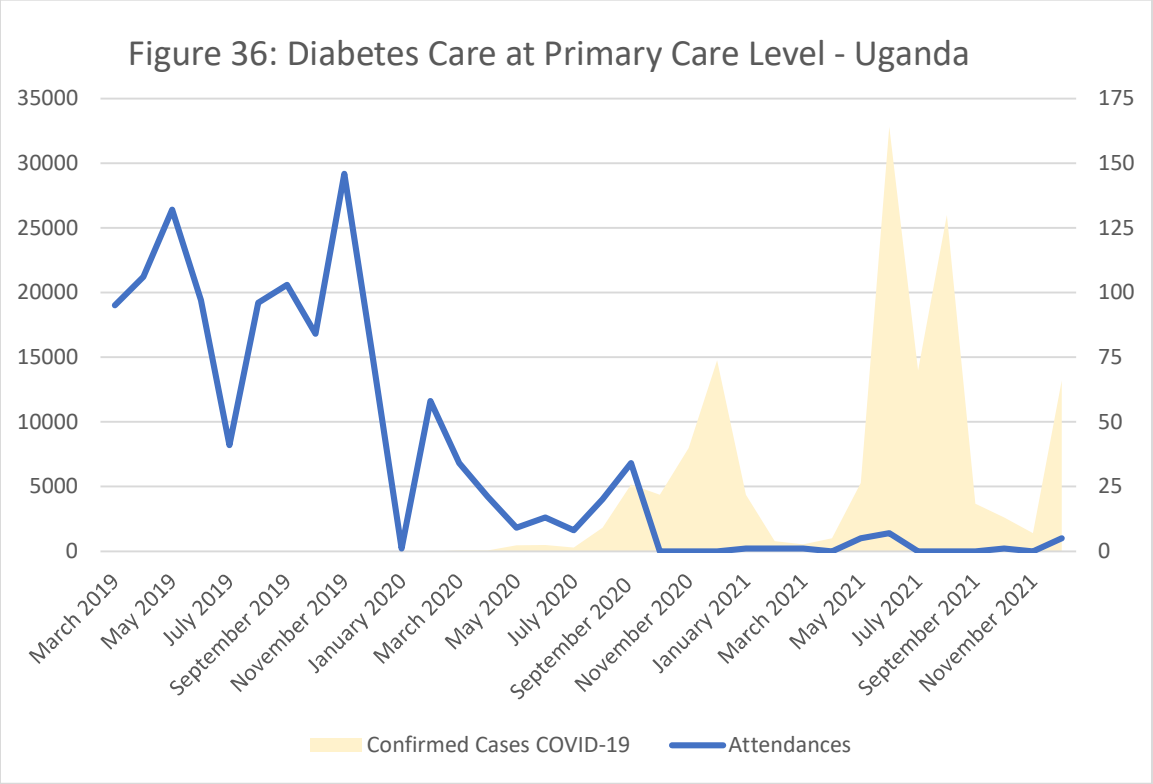


Figure 36: Diabetes Care at Primary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
175
150
125
100
75
50
25
0
March 2019
May 2019
July 2019
September 2019
November 2019
January 2020
March 2020
May 2020
July 2020
September 2020
November 2020
January 2021
March 2021
May 2021
July 2021
September 2021
November 2021
Confirmed Cases COVID-19
Attendances

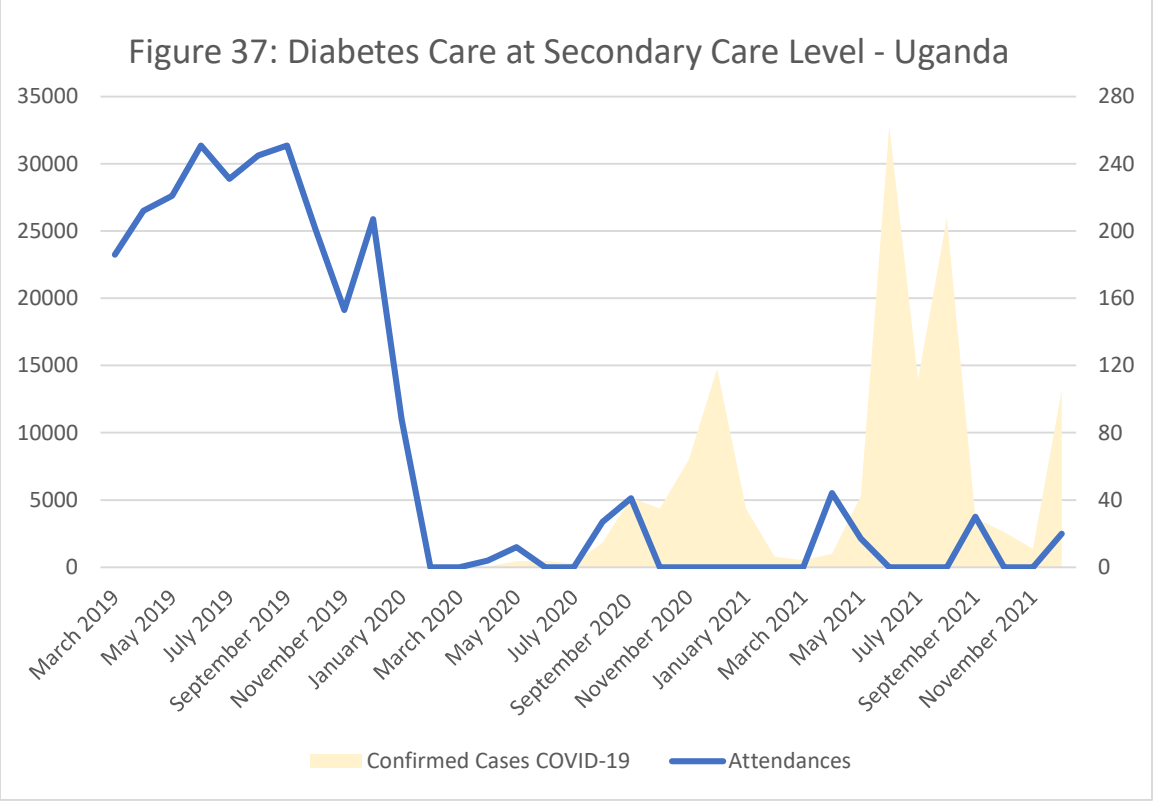


Figure 37: Diabetes Care at Secondary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
280
240
200
160
120
80
40
0
March 2019
May 2019
July 2019
September 2019
November 2019
January 2020
March 2020
May 2020
July 2020
September 2020
November 2020
January 2021
March 2021
May 2021
July 2021
September 2021
November 2021
Confirmed Cases COVID-19
Attendances

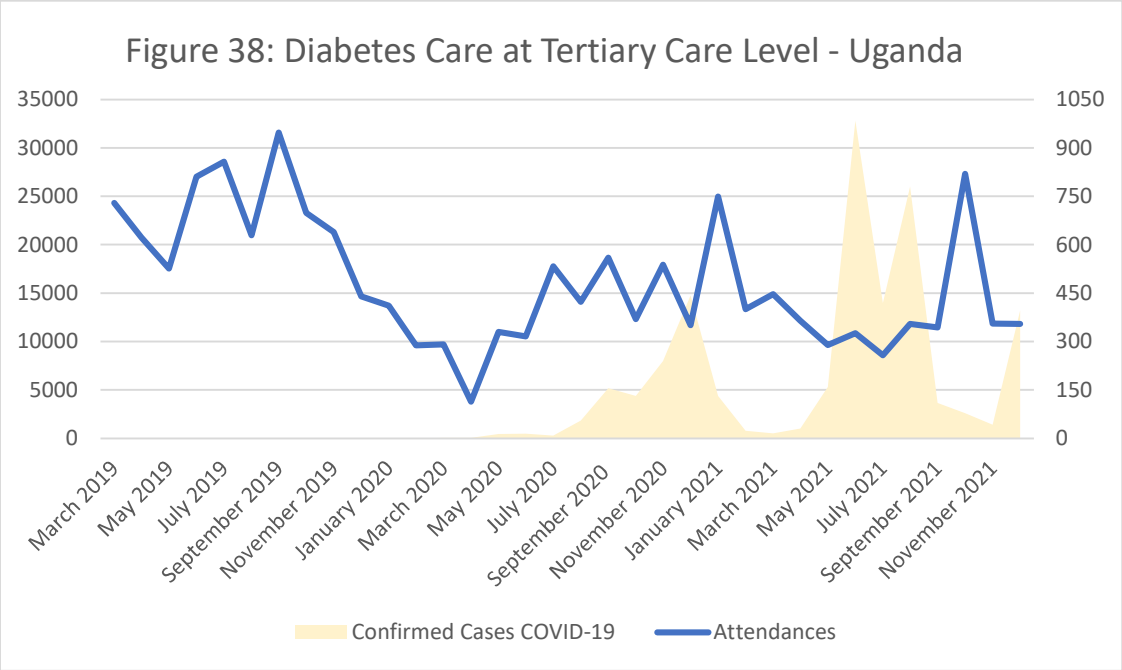


Figure 38: Diabetes Care at Tertiary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
1050
900
750
600
450
300
150
0
March 2019
May 2019
July 2019
September 2019
November 2019
January 2020
March 2020
May 2020
July 2020
September 2020
November 2020
January 2021
March 2021
May 2021
July 2021
September 2021
November 2021
Confirmed Cases COVID-19
Attendances

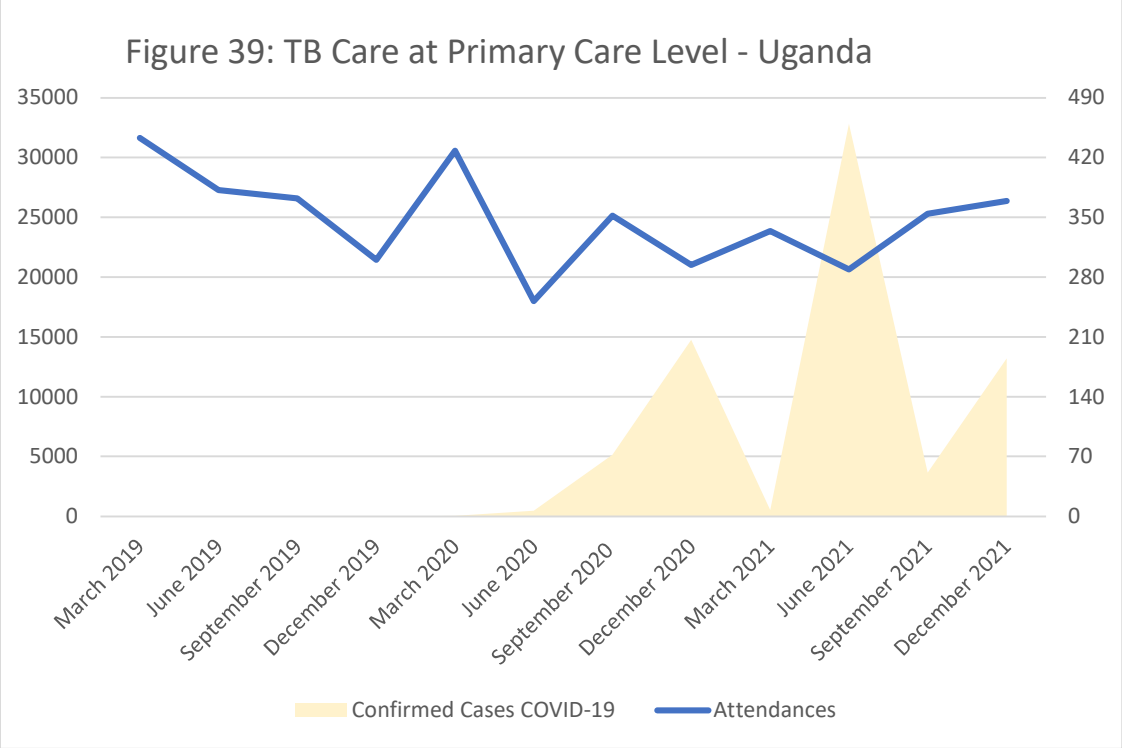


Figure 39: TB Care at Primary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
490
420
350
280
210
140
70
0
March 2019
June 2019
September 2019
December 2019
March 2020
June 2020
September 2020
December 2020
March 2021
June 2021
September 2021
December 2021
Confirmed Cases COVID-19
Attendances

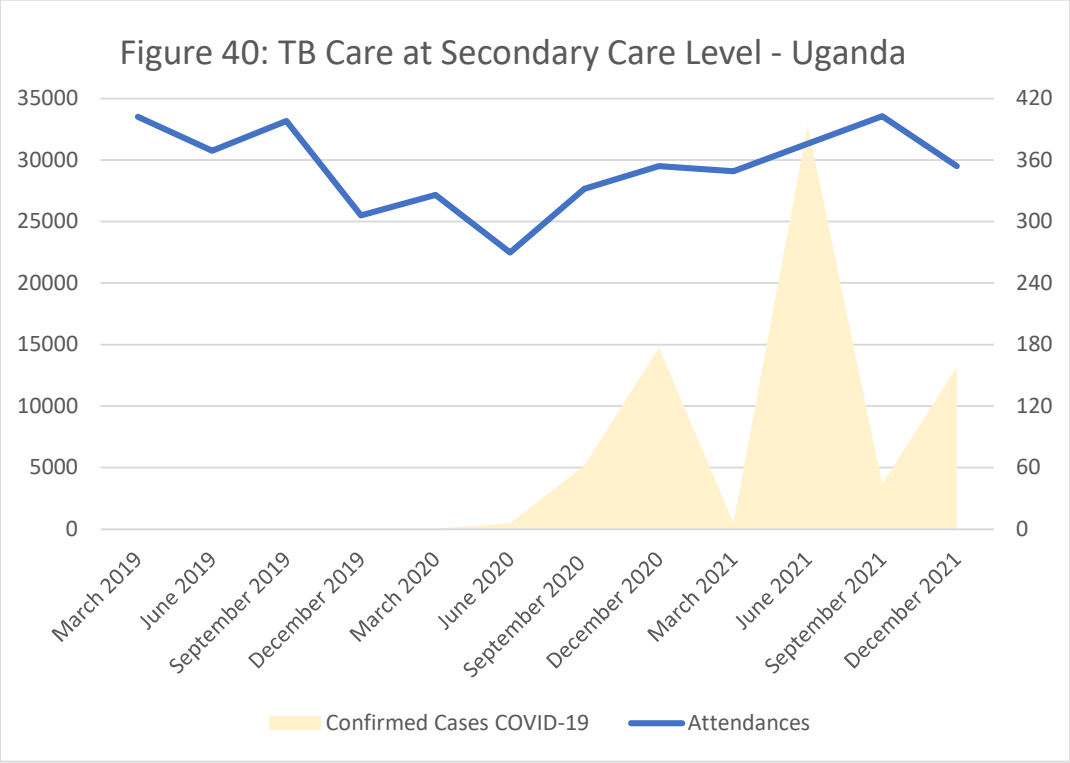


Figure 40: TB Care at Secondary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
420
360
300
240
180
120
60
0
March 2019
June 2019
September 2019
December 2019
March 2020
June 2020
September 2020
December 2020
March 2021
June 2021
September 2021
December 2021
Confirmed Cases COVID-19
Attendances

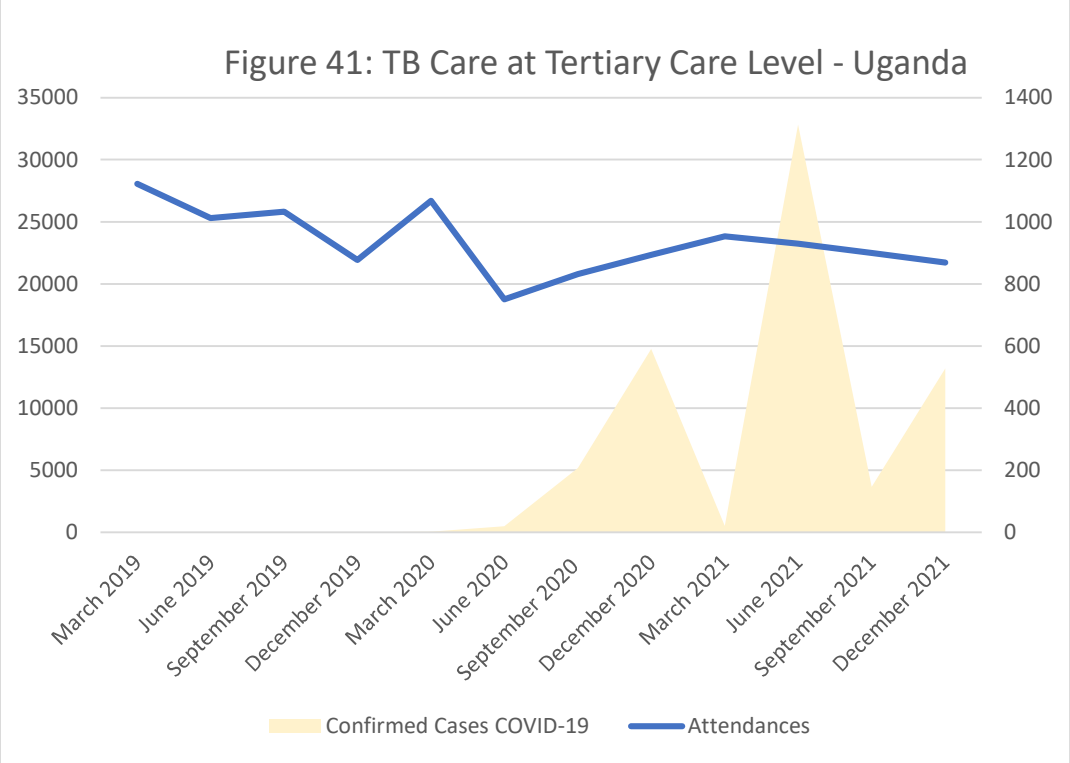


Figure 41: TB Care at Tertiary Care Level - Uganda
35000
30000
25000
20000
15000
10000
5000
0
1400
1200
1000
800
600
400
200
0
March 2019
June 2019
September 2019
December 2019
March 2020
June 2020
September 2020
December 2020
March 2021
June 2021
September 2021
December 2021
Confirmed Cases COVID-19
Attendances

Appendix 3. Graphs of Facility Attendance by Service Delivery – Côte d'Ivoire

Figure 42: Antenatal Care Attendance at Primary Care Level - Côte d'Ivoire

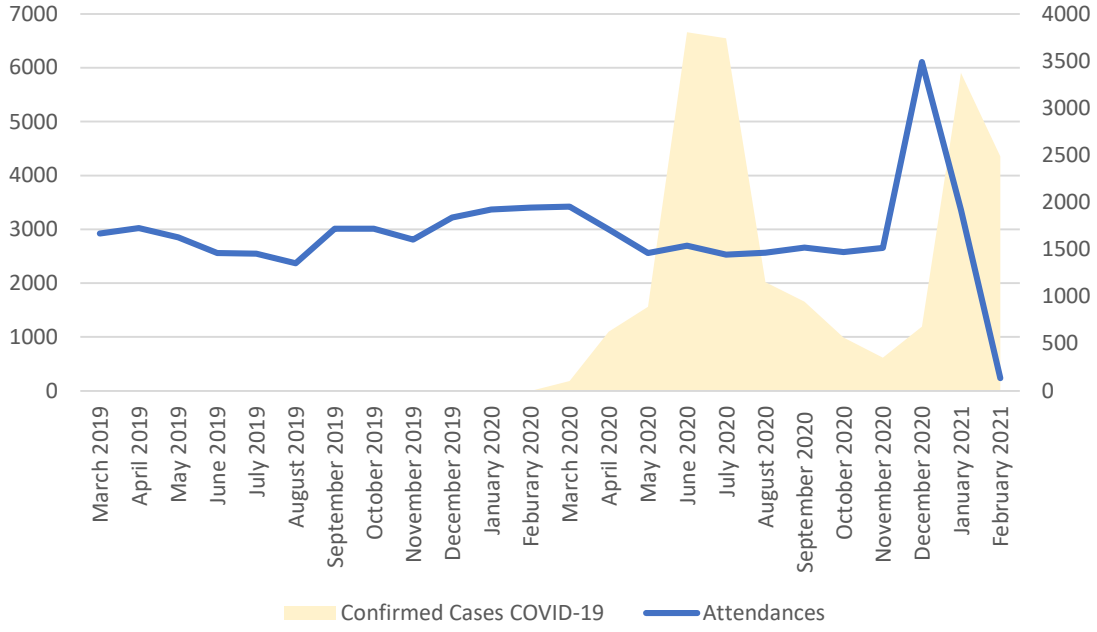
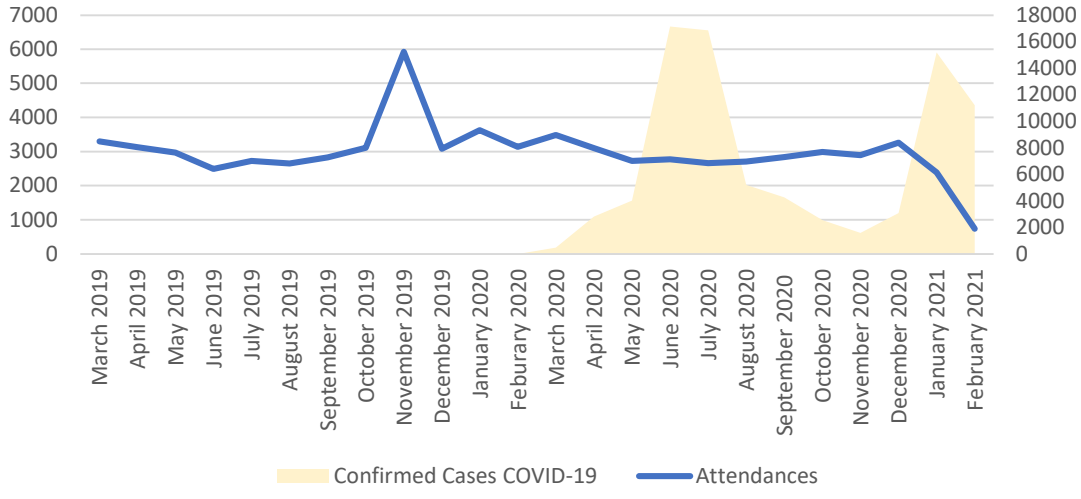


Figure 43: Antenatal Care Attendance at Secondary Care Level - Côte d'Ivoire



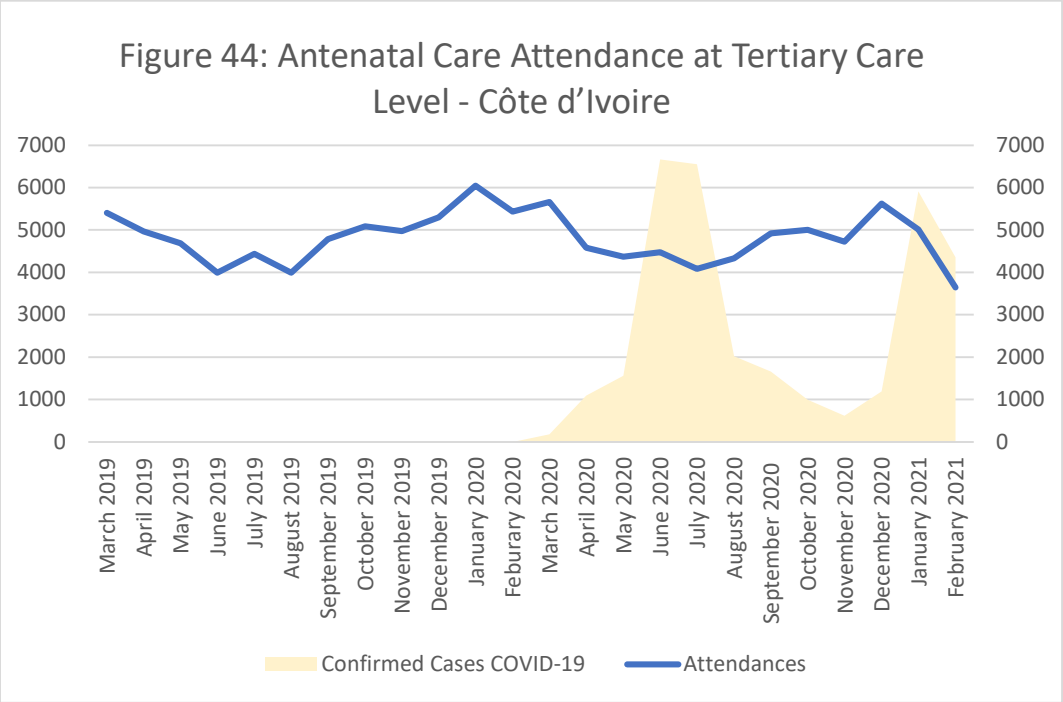


Figure 44: Antenatal Care Attendance at Tertiary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

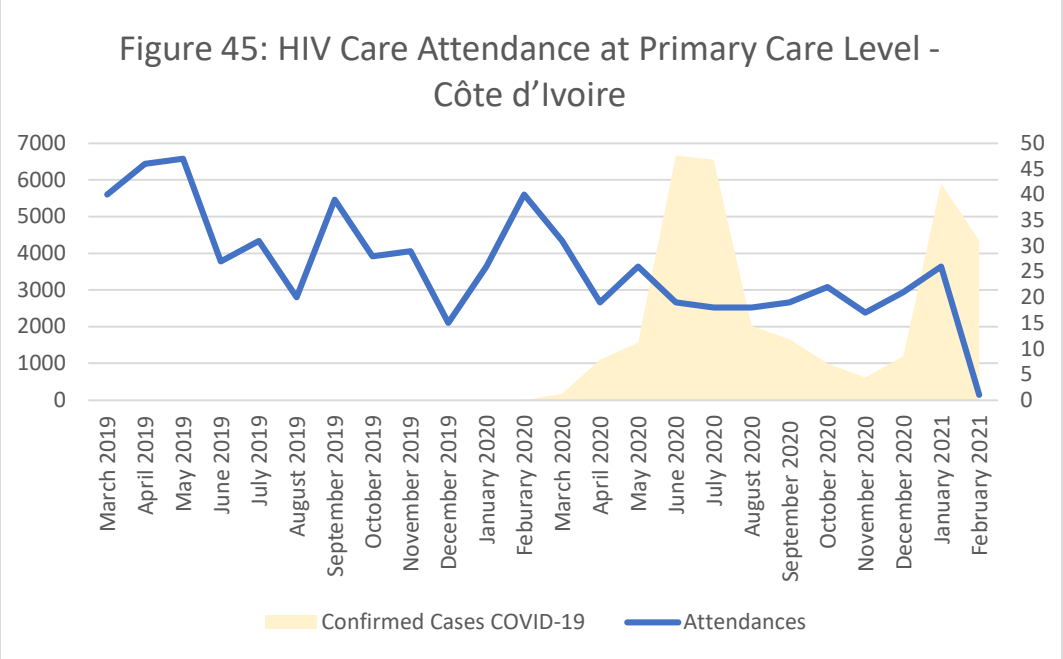


Figure 45: HIV Care Attendance at Primary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
50
45
40
35
30
25
20
15
10
5
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

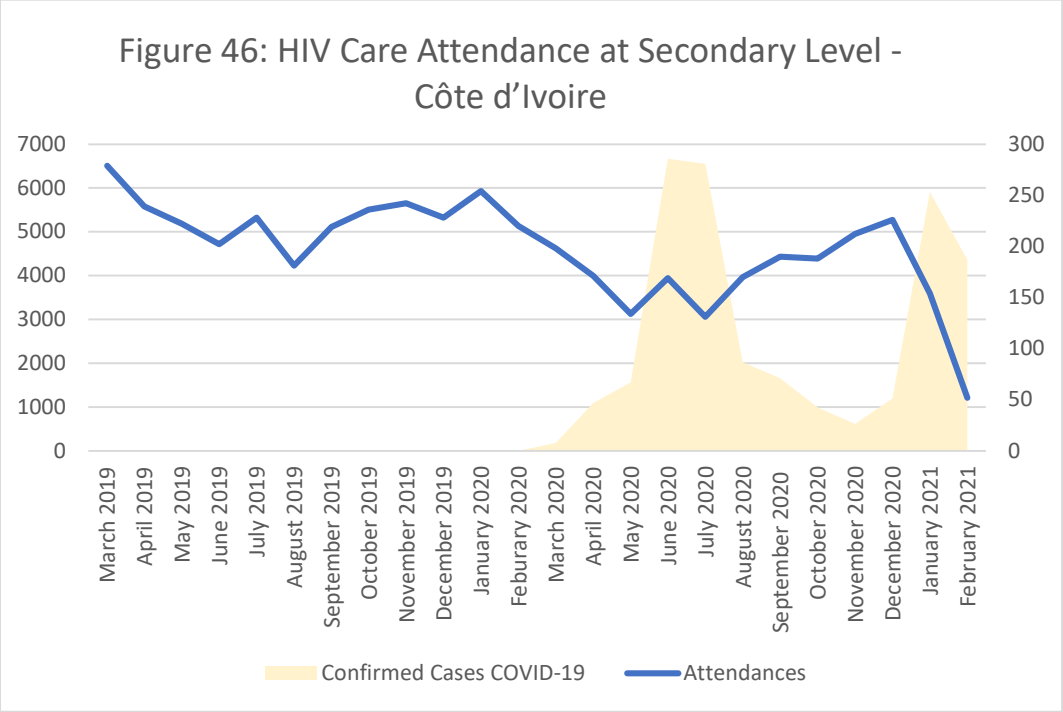


Figure 46: HIV Care Attendance at Secondary Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
300
250
200
150
100
50
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

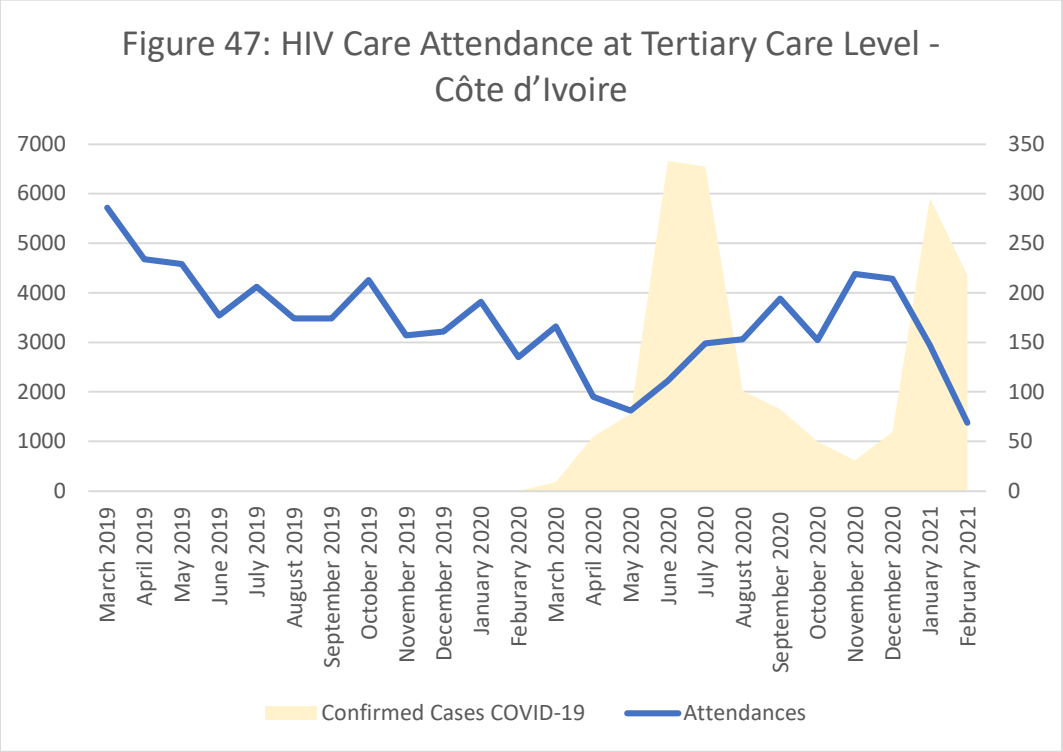


Figure 47: HIV Care Attendance at Tertiary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
350
300
250
200
150
100
50
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

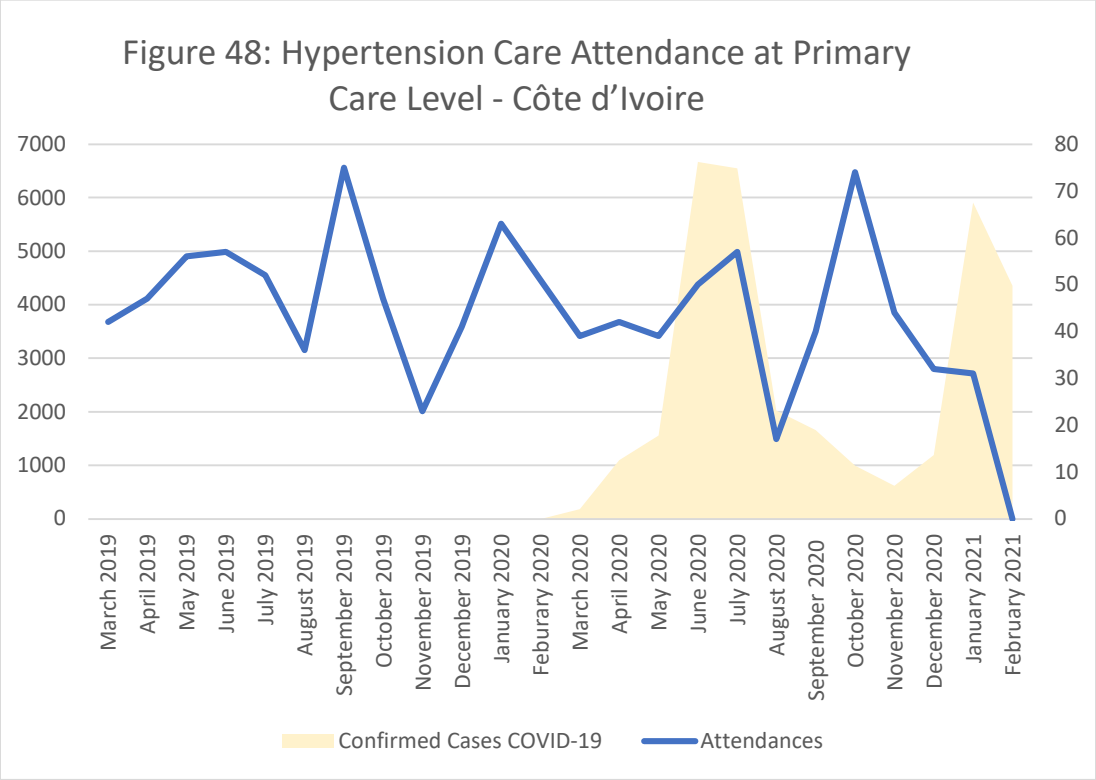


Figure 48: Hypertension Care Attendance at Primary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
80
70
60
50
40
30
20
10
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

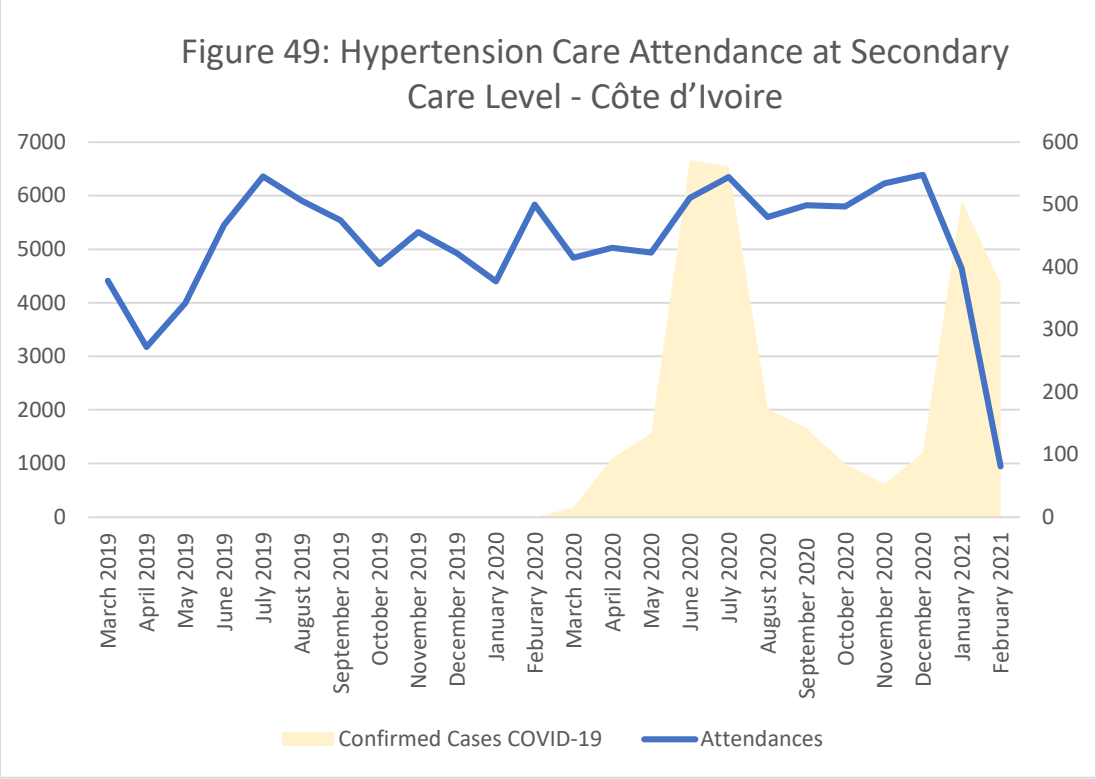


Figure 49: Hypertension Care Attendance at Secondary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
600
500
400
300
200
100
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

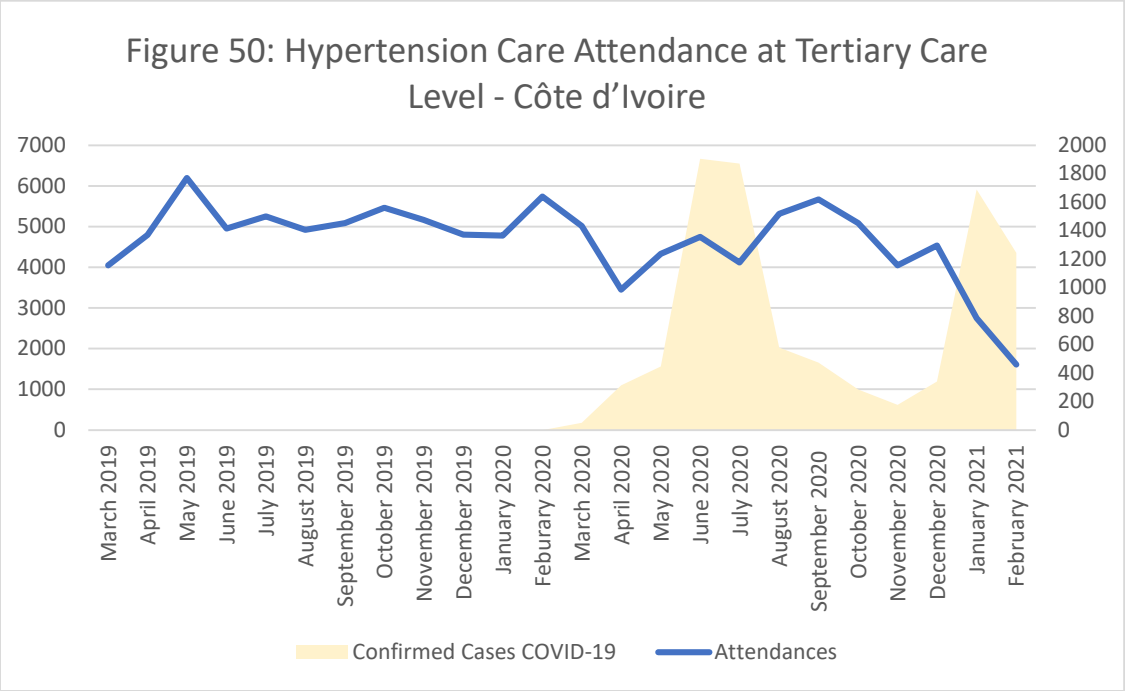


Figure 50: Hypertension Care Attendance at Tertiary Care Level - Côte d'Ivoire

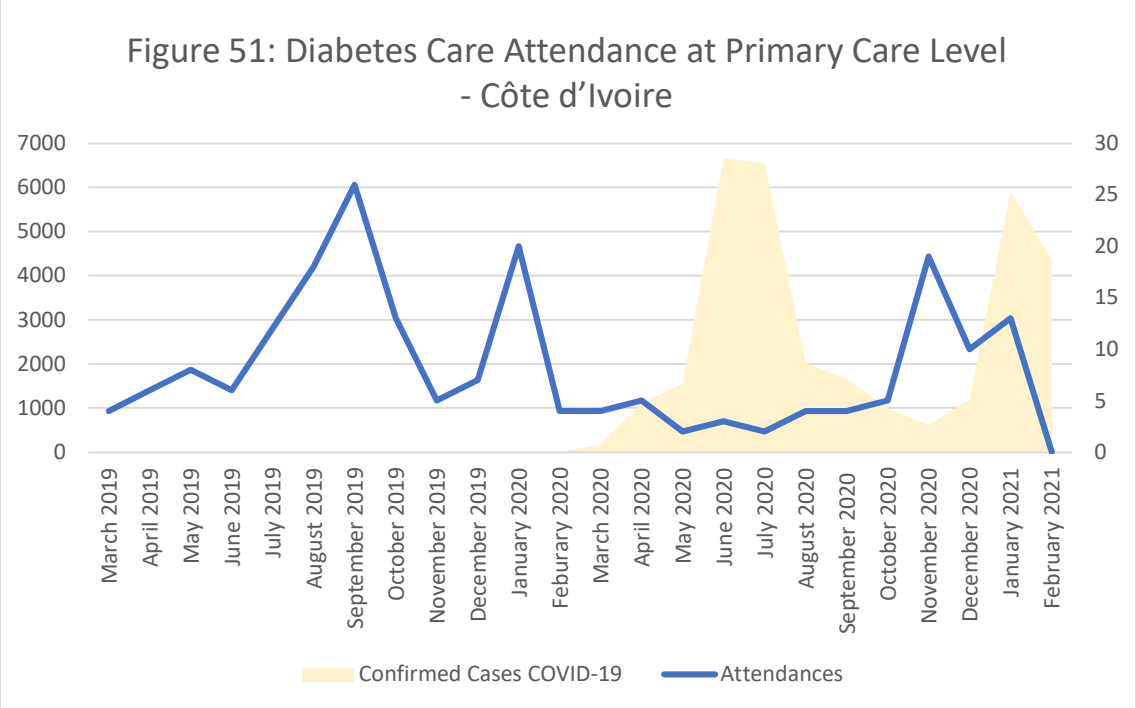


Figure 51: Diabetes Care Attendance at Primary Care Level - Côte d'Ivoire

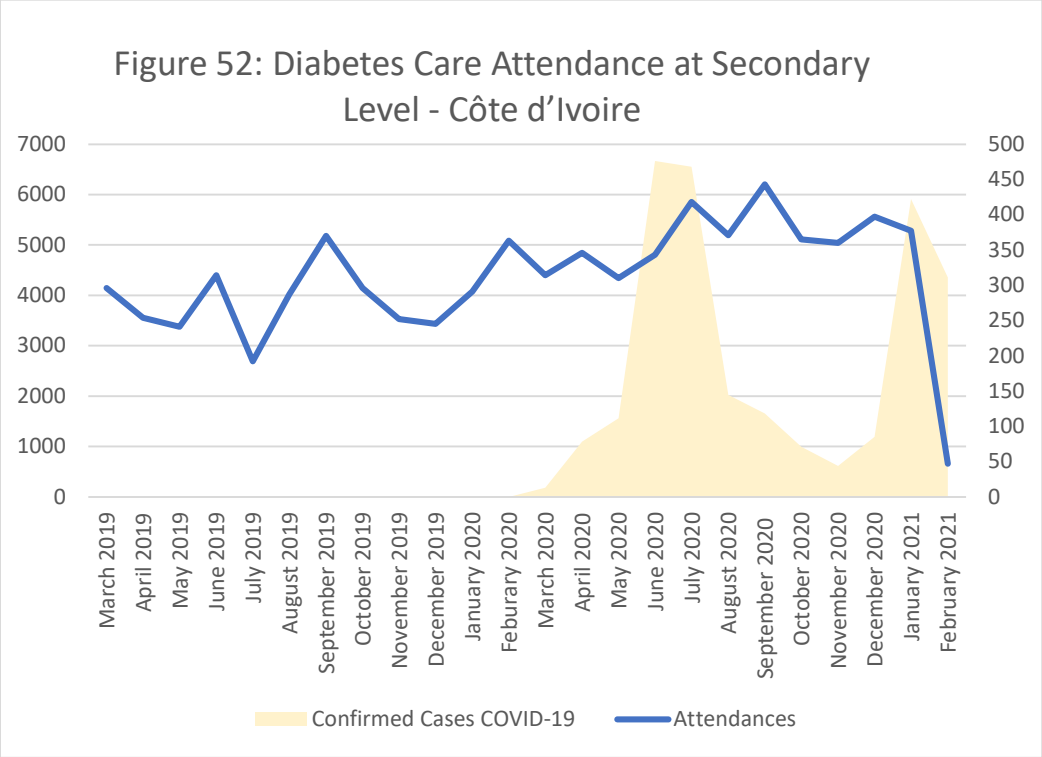


Figure 52: Diabetes Care Attendance at Secondary Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
500
450
400
350
300
250
200
150
100
50
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

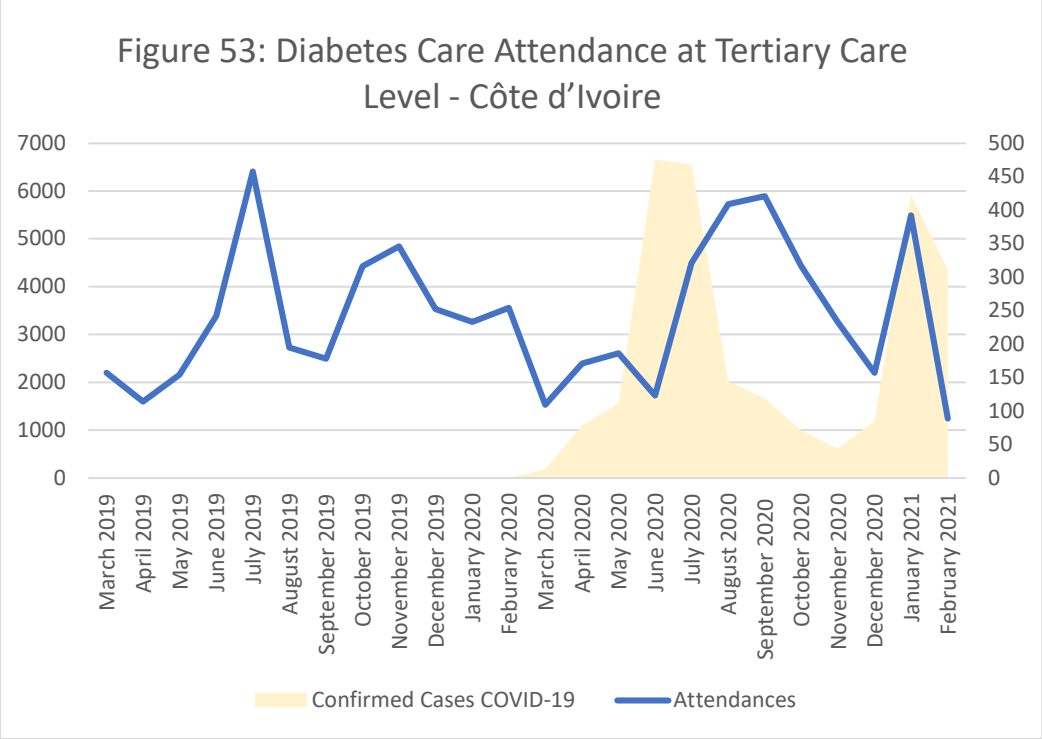


Figure 53: Diabetes Care Attendance at Tertiary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
500
450
400
350
300
250
200
150
100
50
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

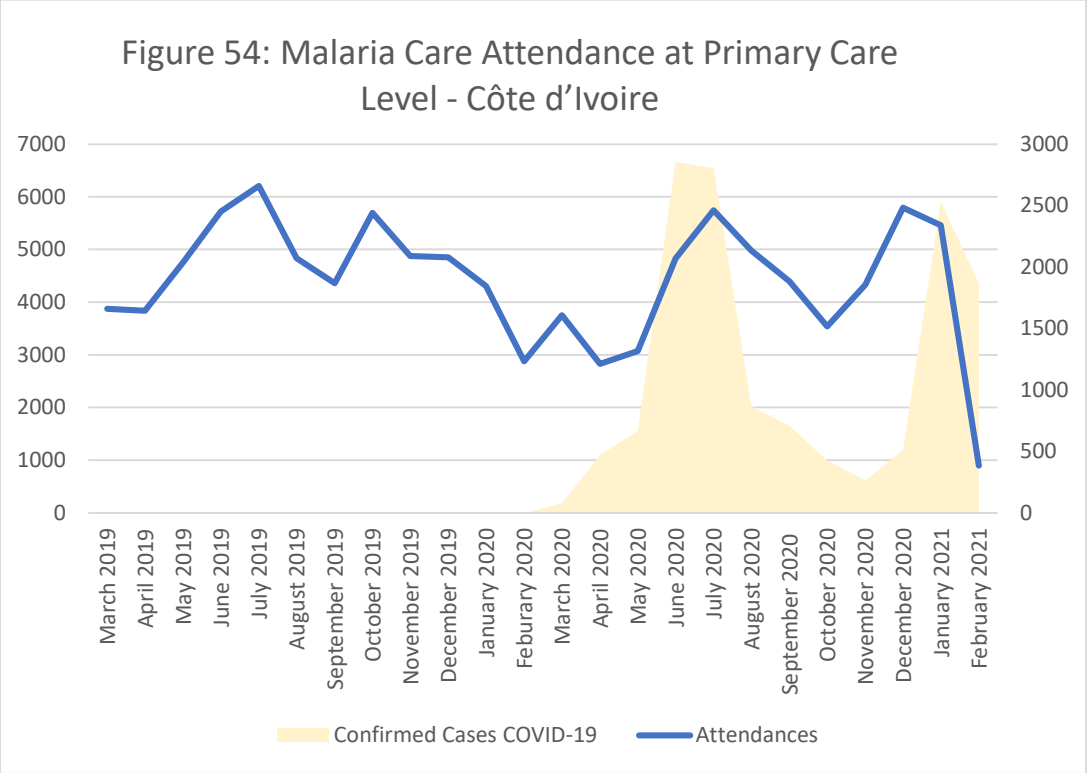


Figure 54: Malaria Care Attendance at Primary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
3000
2500
2000
1500
1000
500
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

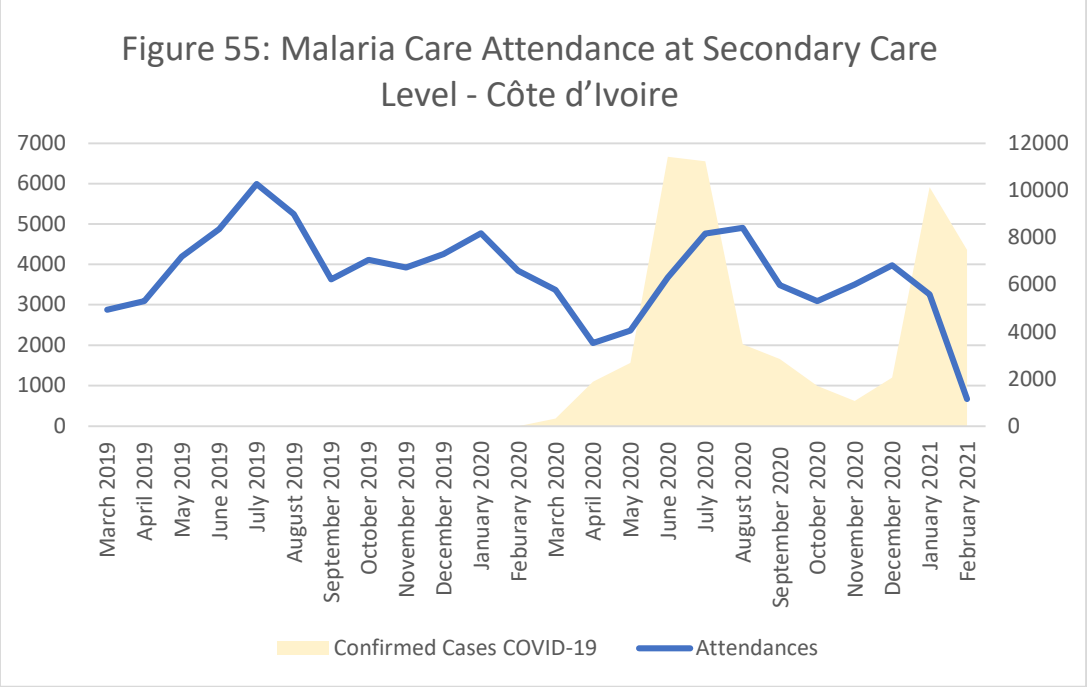


Figure 55: Malaria Care Attendance at Secondary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
12000
10000
8000
6000
4000
2000
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

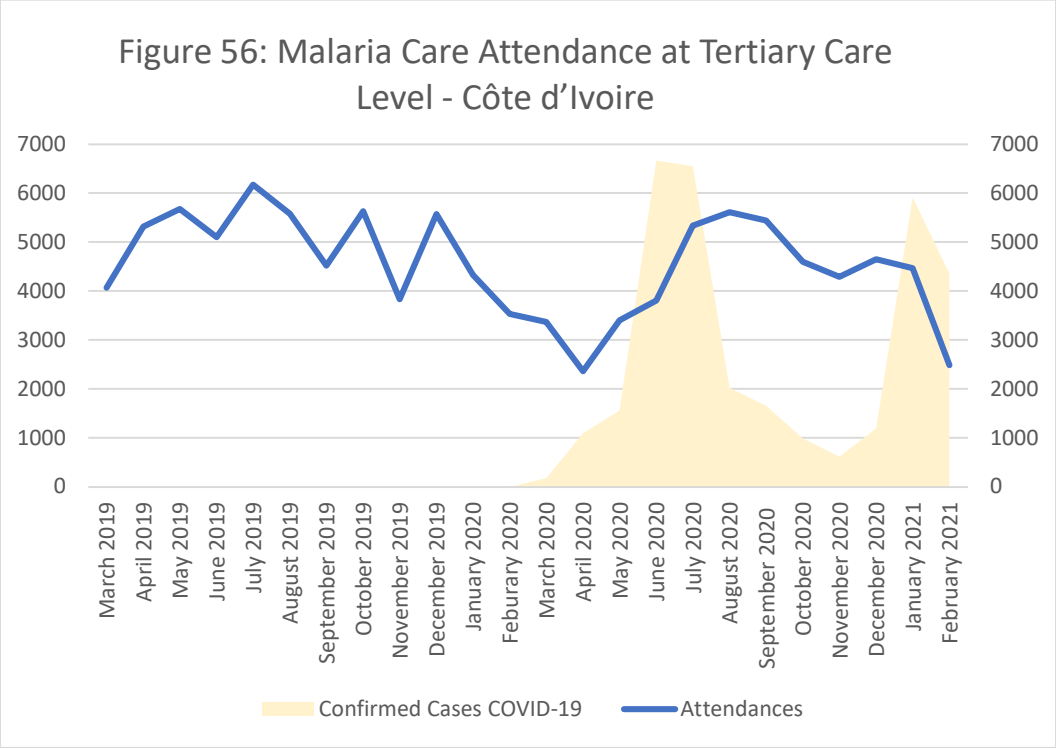


Figure 56: Malaria Care Attendance at Tertiary Care Level - Côte d'Ivoire

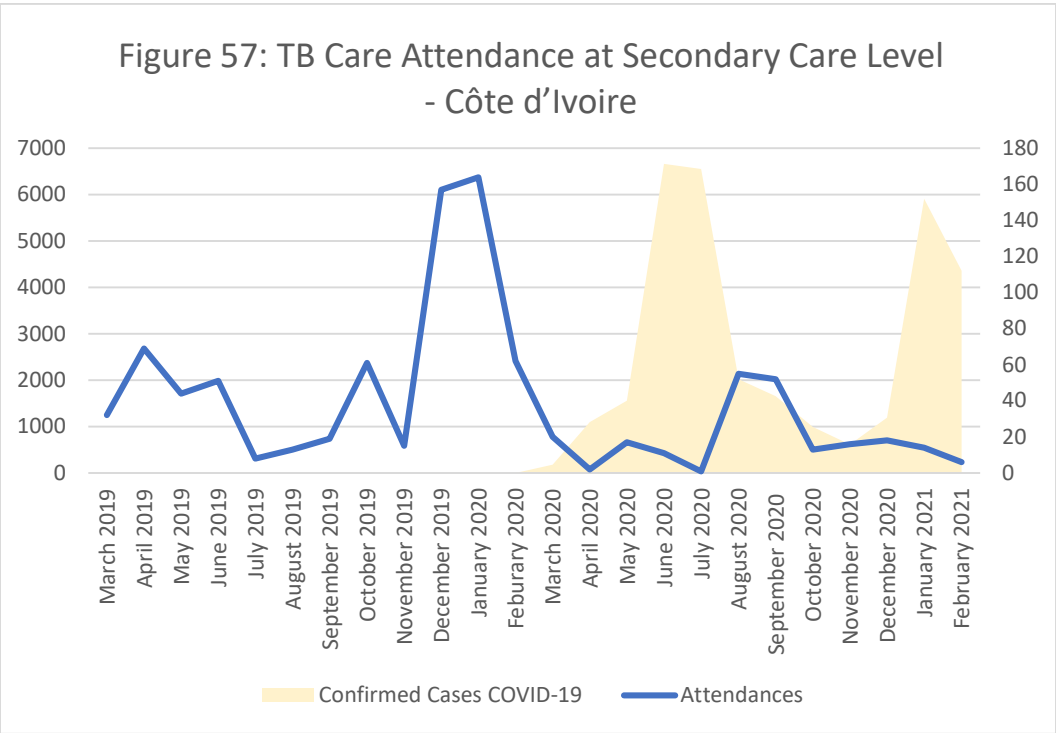


Figure 57: TB Care Attendance at Secondary Care Level - Côte d'Ivoire

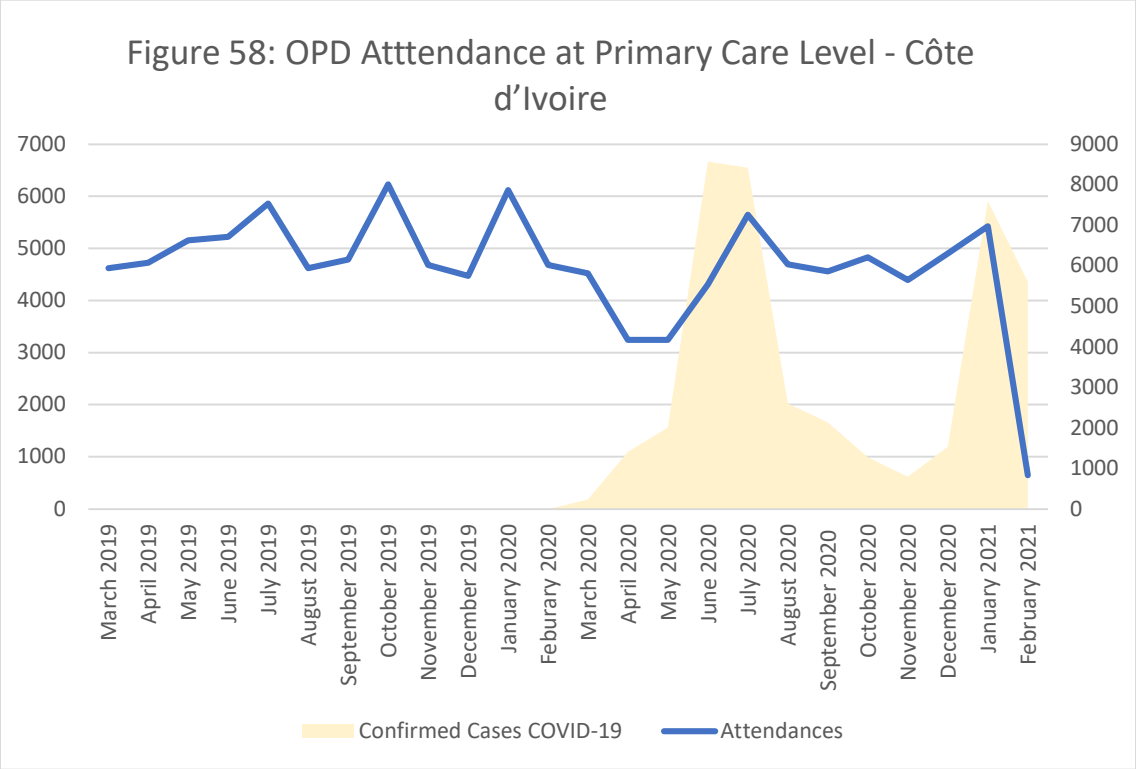


Figure 58: OPD Atttendance at Primary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

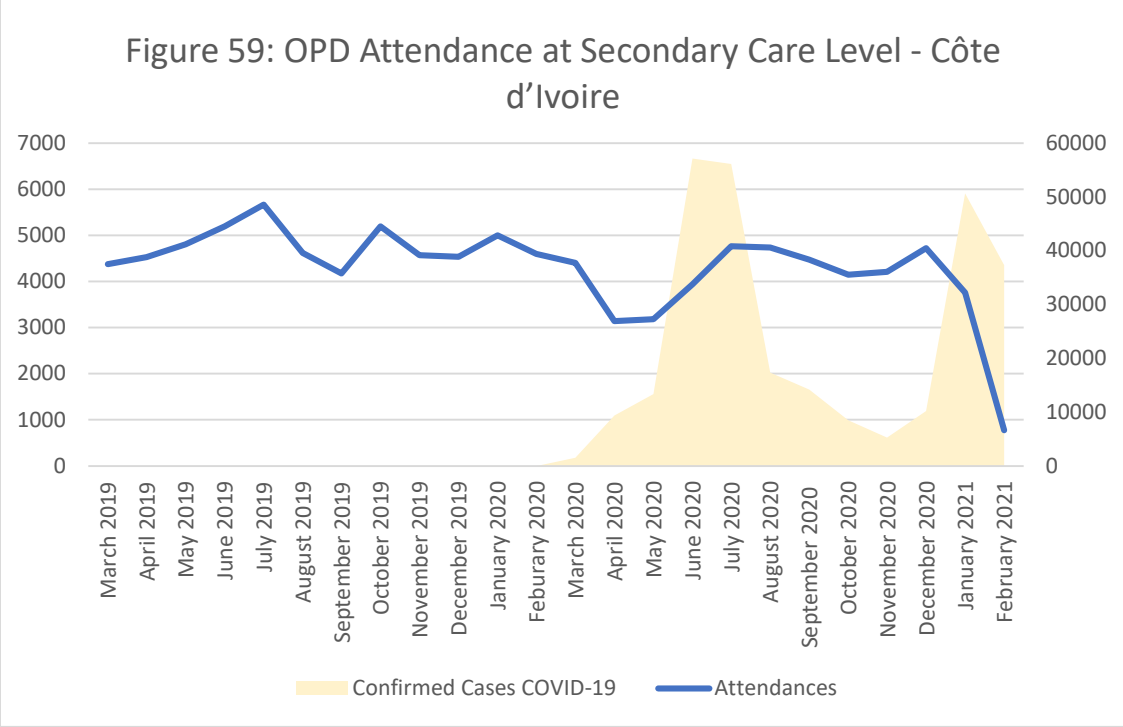


Figure 59: OPD Attendance at Secondary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
60000
50000
40000
30000
20000
10000
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

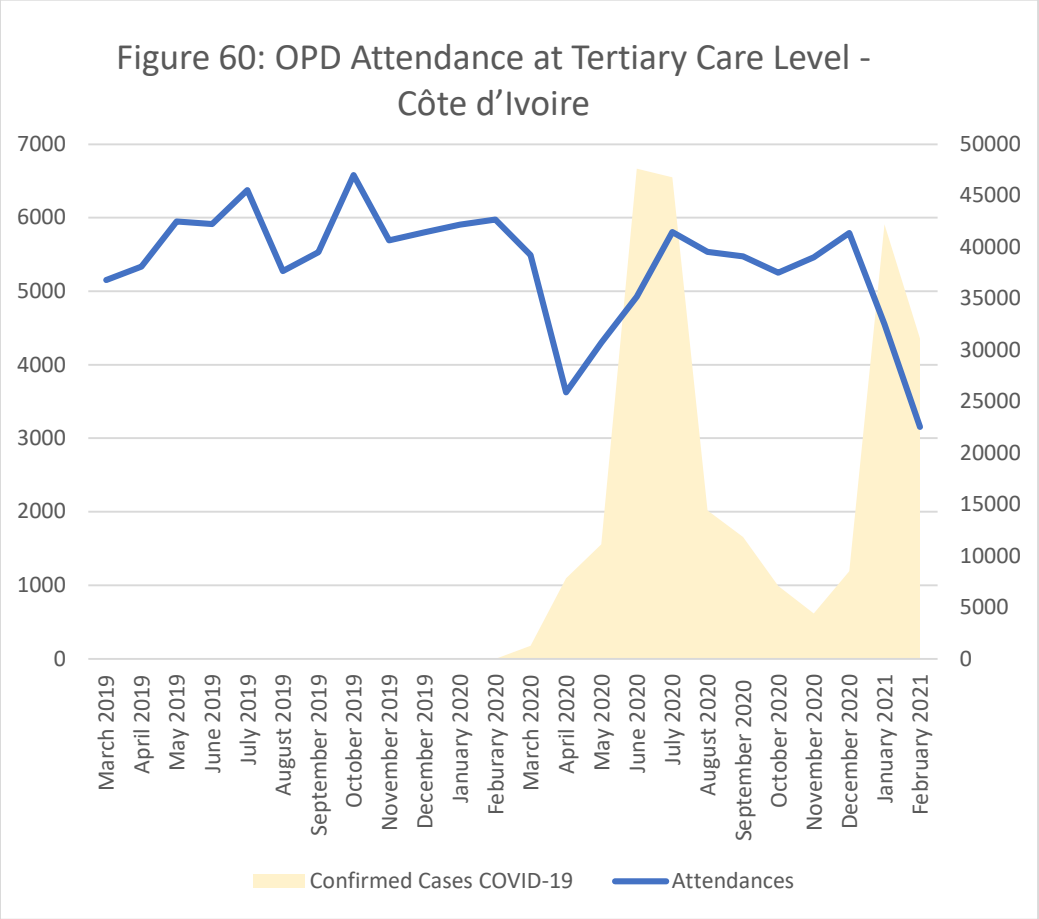


Figure 60: OPD Attendance at Tertiary Care Level - Côte d'Ivoire
7000
6000
5000
4000
3000
2000
1000
0
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
November 2019
December 2019
January 2020
Feburary 2020
March 2020
April 2020
May 2020
June 2020
July 2020
August 2020
September 2020
October 2020
November 2020
December 2020
January 2021
February 2021
Confirmed Cases COVID-19
Attendances

Elizabeth Glaser Pediatric AIDS Foundation (EGPAF)
1350 Eye St NW, Suite 400, Washington, D.C. 20005
Phone: 202-296-9165 | Fax: 202-296-9185
www.pedaids.org