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Impact of the COVID-19 Pandemic on Surgical Care in Rwanda: A Multicentre Retrospective Cross-Sectional Study

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Abstract

Background: The COVID-19 pandemic significantly disrupted global healthcare, with Rwanda reporting 133,078 cases and 1,468 deaths by January 2023. Lockdowns, healthcare worker shortages, and resource reallocation affected surgical care. This study evaluates the impact of COVID-19 and lockdown measures on surgical outpatient consultations, procedural volumes, and inpatient outcomes in Rwanda.

Methods: A retrospective, multicentre cross-sectional study was conducted across 22 hospitals, covering university teaching, referral, provincial, district, and private facilities. Data were extracted from hospital records for two periods: pre-pandemic (March 2019–February 2020) and pandemic (March 2020–February 2021). Lockdown phases were classified into country-wide and district-specific restrictions. Primary outcomes included outpatient consultation volumes, surgical procedures, and inpatient metrics (ICU admissions, length of stay, mortality, and transfers). Statistical analysis used general linear models to adjust for confounders.

Results: The study included 507,627 surgical outpatients and 68,701 inpatients. While total outpatient consultations increased slightly during the pandemic year (264,114 vs. 243,513 pre-pandemic), consultations dropped by 39% during country-wide lockdowns. The total number of surgical procedures remained stable (34,192 vs. 34,509 pre-pandemic), though emergency surgeries declined. Surgical volumes decreased during district lockdowns but increased slightly during national lockdowns. ICU admissions were lower (0.6% vs. 0.9%), while hospital length of stay remained largely unchanged. Surgical patient mortality decreased from 0.66% to 0.36%, with a decline in interhospital transfers, particularly from district hospitals.

Conclusion: Despite pandemic-related disruptions, Rwanda's surgical service delivery remained resilient, likely due to proactive public health measures and resource management. While lockdowns affected surgical access, overall surgical volumes and patient outcomes were preserved. These findings highlight the importance of strategic planning in maintaining essential surgical care during health crises.

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Introduction

The COVID-19 pandemic has drastically impacted healthcare delivery globally, with Rwanda reporting 133,078 confirmed cases and 1,468 deaths by January 2023[1]. The pandemic strained healthcare systems, leading to shortages of healthcare workers, PPE, and ventilators[2]. Elective surgeries were often cancelled to allocate resources to COVID-19 patients and reduce risk[2,3]. Previous studies have documented reductions in elective surgeries and team members due to reallocation or contamination [4,5].

In Africa, including Rwanda, fragile healthcare systems are expected to face severe challenges[6]. Rwanda implemented early lockdowns and public health measures, including social distancing, testing, isolation, and contact tracing, which helped control the infection spread and gradually resume activities. Rwanda's healthcare system is pyramidal, with patients initially visiting health centers, then district hospitals, and finally referral hospitals if needed. In 2020, there were about 115 specialist-level surgeons for a population of 12 million, predominantly in urban centers. District hospitals perform 89% of surgeries, mostly caesarean sections by general practitioners, while more complex surgeries occur in teaching and referral hospitals[7].

Several measures were put in place from March 2020 up to 2021 to fight and decrease the spread of the pandemic into the population. Among those sanitary measures, there was the mandatory policy of wearing masks, hand washing, and other hygienic measures such as sanitizing airport areas, and public markets, and different levels of lockdowns and curfews. Those lockdowns were at the level of the country with a closure of borders except for essential goods and essential travel, those were referred to as “country lockdowns” and there were four in total as of December 2021. Furthermore, depending on the number of cases within a district, “district lockdowns” were put in place to limit the movement of goods and the population within those specific districts. Only essential goods and essential workers were allowed to move freely while respecting the sanitary measures in place.

The COVID-19 pandemic and its containment measures, including national and district-level lockdowns, had a significant impact on surgical care in Rwanda. These disruptions likely led to reductions in the availability of surgical services due to the reallocation of resources, healthcare worker shortages, and limitations on patient movement. The primary aim of this study was to evaluate the impact of the COVID-19 pandemic on surgical care in Rwanda, specifically in terms of outpatient consultations, surgical volumes, and inpatient outcomes. The secondary objective was to assess the effect of lockdown measures (both national and district-level) on the delivery of surgical care and associated patient outcomes.

Methods

Study Design

This was a multicentre, retrospective cross-sectional study conducted across 22 hospitals in Rwanda. These hospitals represented different levels of the healthcare system, including university teaching, referral, provincial, district, and private hospitals. The selection ensured regional representation and accounted for variations in healthcare delivery across different facility types.

Data Collection

Patient data were retrospectively extracted from hospital logbooks and digital health management systems by trained data collectors. Information regarding national and district lockdown periods was obtained from Rwanda Cabinet Resolutions. The study period was defined as March 2019–February 2020 (pre-COVID-19) and March 2020–February 2021 (COVID-19 year).

Lockdown Definitions

Lockdown measures implemented during the pandemic were classified into two categories. Country lockdowns referred to periods when all non-essential movement was prohibited nationwide, restricting mobility except for essential services. District lockdowns, on the other hand, were imposed based on local infection rates, limiting movement within specific districts while permitting only essential travel. These measures were designed to mitigate the spread of COVID-19 while balancing the need for essential healthcare services, including surgical care.

Primary Outcome Measures

The primary outcomes assessed in this study included the volume of outpatient surgical consultations and the total number of surgical procedures performed. Additionally, inpatient outcomes were evaluated, focusing on ICU admissions, length of hospital stay, patient transfers, and overall mortality rates. These measures provided a comprehensive understanding of how surgical care was impacted during the COVID-19 pandemic.

Secondary Outcome Measures

The secondary outcomes examined the differential effects of national versus district-level lockdowns on the delivery of surgical care. This analysis aimed to determine whether stricter nationwide restrictions had a greater impact on surgical services compared to more localised district-specific measures. Furthermore, changes in patient outcomes based on these lockdown restrictions were evaluated to assess how access to and quality of surgical care fluctuated during different phases

of the pandemic.

Data Analysis

To assess the impact of the COVID-19 period and lockdowns on surgical care, we employed bivariate regression models to determine unadjusted effects. We then used general linear models to estimate adjusted effects, controlling for hospital type, surgical specialty, procedure urgency (emergency vs. elective), and demographic factors (age and gender). Interaction

Table 1. The output of Poisson generalized linear mixed model testing COVID-19 effect on log count of outpatient cases number (N=507627 cases).

Predictors	Estimate ± standard error	t value	P-value	Adjusted OR (95% CI)
COVID-19 year				
No (Reference)				
Yes	0.169 ± 0.037	4.562	<0.01	1.18 (1.101-1.27)
Country lockdown				
No (Reference)				
Yes	-0.498 ± 0.105	-4.744	<0.01	0.61 (0.495-0.75)
District lockdown				
No (Reference)				
Yes	0.135 ± 0.099	1.366	0.172	1.14 (0.943-1.39)
Controls				
Hospitals level				
District Hospitals (Reference)				
Hospitals - Provincial	-0.103 ± 1.186	-0.087	0.931	0.90 (0.088-9.22)
Hospitals - Referral	0.001 ± 1.185	0.001	0.999	1.00 (0.098-10.22)
Hospitals - University Teaching	-0.419 ± 1.186	-0.353	0.724	0.66 (0.064-6.73)
Hospitals - Private	0.663 ± 1.190	0.557	0.578	1.94 (0.188-19.99)
General surgery				
No (Reference)				
Yes	-0.138 ± 0.044	-3.165	<0.01	0.87 (0.800-0.95)
Urology				
No (Reference)				
Yes	1.131 ± 0.113	9.973	<0.01	3.10 (2.481-3.87)
Orthopedics				
No (Reference)				
Yes	0.957 ± 0.071	13.420	<0.01	2.60 (2.265-3.00)
ENT				
No (Reference)				
Yes	-0.283 ± 0.065	-4.344	<0.01	0.75 (0.663-0.86)
Obstetrics and Gynecology				
No (Reference)				
Yes	1.085 ± 0.044	24.755	<0.01	2.96 (2.715-3.22)
Pediatric surgery				
No (Reference)				
Yes	0.115 ± 0.099	1.163	0.245	1.12 (0.924-1.36)
Maxillo-facial surgery				
No (Reference)				
Yes	0.114 ± 0.126	0.908	0.364	1.12 (0.876-1.44)
Ophthalmology				
No (Reference)				
Yes	0.935 ± 0.088	10.567	<0.01	2.55 (2.141-3.03)
Cardiothoracic surgery				
No (Reference)				
Yes	-0.346 ± 0.124	-2.787	<0.01	0.71 (0.555-0.90)

effects between age and gender were also assessed. Missing data were excluded from the analysis, and model significance was evaluated using likelihood ratio tests. All statistical analyses were conducted in R software using appropriate statistical packages.

Ethical Considerations

This study received approval from the Rwanda National Ethics Committee (N°704/RNEC/2021) and the National Health Research Committee (No NHRC/2021/PROT/032). All patient data were anonymised and de-identified in accordance with ethical guidelines to ensure confidentiality.

Results

The study included 507,627 surgical outpatients and 68,701 surgical inpatients across 22 hospitals (figure 1).

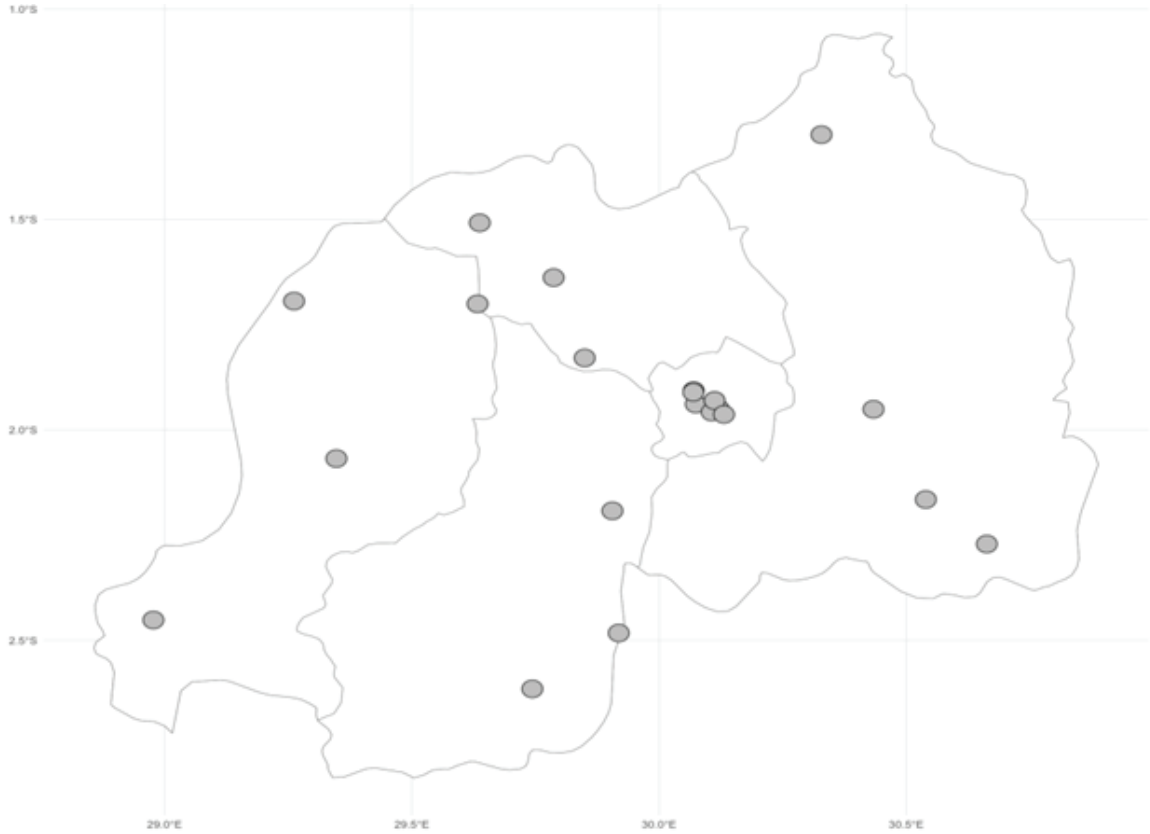

Figure 1: Distribution of the study hospitals (N=22) across the country

Impact on Surgical Outpatients

During the COVID-19 year, 264,114 outpatient consultations were recorded, compared to 243,513 in the pre-pandemic year. While overall outpatient consultations remained stable, a significant decrease was observed during lockdowns. Weekly consultations dropped to a median of 27 during country lockdowns and 32 during district lockdowns, compared to 45 and 44 in non-lockdown periods, respectively (Table 1). After adjusting for confounders, outpatient consultations increased by 18% over the COVID-19 year but declined by 39% during country *lockdowns, with no significant change during district lockdowns.*

Impact on Surgical Procedures

A total of 34,192 surgeries were performed during the COVID-19 year, slightly fewer than the 34,509 conducted pre-pandemic. Emergency surgeries declined from 14,788 pre-pandemic to 14,010 during the COVID-19 year. During country lockdowns, surgical volume slightly increased, whereas district lockdowns led to a decline, with daily surgeries dropping from a median of 87 to 51 (Table 2).

Types of Surgical Cases

The most frequently performed procedure in both periods was cesarean section, accounting for approximately 60% of all surgeries (20,368 cases in the COVID-19 year vs. 20,644 pre-pandemic). Unlisted procedures comprised around 32% of cases, with a slight increase observed during lockdowns. Other common procedures included urology surgeries, umbilical repairs, and laparotomies,

Table 2. The output of Poisson generalized linear mixed model testing COVID-19 effect on log count of inpatient cases number (N= 68701 cases).

Factor	Estimate ± Standard Error	t value	P value	Adjusted OR (95% CI)
COVID-19 year				
No (Reference)				
Yes	-0.064 ± 0.005	-13.391	<0.01	0.94 (0.93-0.95)
Country lockdown				
No (Reference)				
Yes	0.053 ± 0.010	5.246	<0.01	1.05 (1.03-1.08)
District lockdown				
No (Reference)				
Yes	-0.025 ± 0.008	-3.077	0.002	0.98 (0.96-0.99)
Controls				
Hospital level	District Hospitals (Reference)			
Provincial Hospitals	-0.035 ± 0.129	-0.268	0.789	0.97 (0.75-1.24)
Referral Hospitals	0.045 ± 0.129	0.346	0.73	1.05 (0.81-1.35)
University Teaching Hospitals	0.084 ± 0.129	0.656	0.512	1.09 (0.84-1.40)
Private Hospitals	0.099 ± 0.129	0.764	0.445	1.10 (0.86-1.42)
Timing	Elective (Reference)			
Emergency	-0.043 ± 0.005	-9.303	<0.01	0.96 (0.95-0.97)
Age	0 to 10 (Reference)			
11 to 20	-0.089 ± 0.016	-5.594	<0.01	0.91 (0.89-0.94)
21 to 30	0.191 ± 0.015	13.087	<0.01	1.21 (1.18-1.25)
31 to 40	0.161 ± 0.016	11.028	<0.01	1.17 (1.14-1.21)
41 to 50	-0.093 ± 0.017	-5.963	<0.01	0.91 (0.88-0.94)
51 and above	-0.022 ± 0.017	-1.315	0.189	0.98 (0.95-1.01)
Gender	Female (Reference)			
Male	0.103 ± 0.016	6.494	<0.01	1.11 (1.07-1.14)
Age*Gender	0 to 10*Male (Reference)			
11 to 20*Male	-0.012 ± 0.021	-0.559	0.576	0.99 (0.95-1.03)
21 to 30*Male	-0.290 ± 0.020	-14.349	<0.01	0.75 (0.72-0.78)
31 to 40*Male	-0.255 ± 0.020	-12.748	<0.01	0.77 (0.75-0.81)
41 to 50*Male	-0.034 ± 0.022	-1.565	0.117	0.97 (0.93-1.01)
51 and above*Male	-0.005 ± 0.021	-0.218	0.827	1.00 (0.96-1.04)
General surgery	No (Reference)			
Yes	-0.010 ± 0.007	-1.57	0.116	0.99 (0.98-1.00)
Urology	No (Reference)			
Yes	-0.090 ± 0.016	-5.476	<0.01	0.91 (0.88-0.94)
Orthopedics	No (Reference)			
Yes	-0.020 ± 0.008	-2.424	0.002	0.98 (0.97-1.00)
ENT	No (Reference)			
Yes	-0.041 ± 0.009	-4.802	<0.01	0.96 (0.94-0.98)
Neurosurgery	No (Reference)			
Yes	-0.079 ± 0.018	-4.334	<0.01	0.92 (0.89-0.96)
Plastic surgery	No (Reference)			
Yes	-0.049 ± 0.023	-2.161	0.031	0.95 (0.91-1.00)
Obstetrics and Gynecology	No (Reference)			
Yes	0.203 ± 0.008	24.791	<0.01	1.22 (1.21-1.24)
Pediatric surgery	No (Reference)			
Yes	-0.059 ± 0.022	-2.663	0.007	0.94 (0.90-0.98)
Maxillo-facial surgery	No (Reference)			
Yes	-0.025 ± 0.022	-1.144	0.253	0.97 (0.93-1.02)
Ophthalmology	No (Reference)			
Yes	0.246 ± 0.014	16.973	<0.01	1.28 (1.24-1.32)
Cardiothoracic surgery	No (Reference)			
Yes	-0.217 ± 0.027	-8.062	<0.01	0.80 (0.76-0.85)

Table 3. Cases types during COVID-19 versus the pre-COVID-19 period.

Operation category	Pre-COVID-19 Year	COVID-19 Year
Colon and rectum: creation of stoma and takedown, perforations repair, abdominoperineal resection, colon resection and reconstruction,...	127	81
Esophagus and stomach: antireflux procedures, myotomy, esophageal perforation repairs, esophagectomy,...	119	147
Stomach: gastrectomy, gastric perforations repair, feeding gastrostomy, bypass surgery,...	316	298
Hepatobiliary procedures: cholecystectomy, ERCP, CBD exploration, biliary diversion, liver abscess drainage, liver mass excision/lobectomy,...	316	298
Pancreas: Whipple procedure,...	1	4
Small bowel: resection anastomosis, perforations, obstruction, stoma takedown,...	97	110
Other Abdominal surgeries: appendectomy, laparotomies for intrabdominal abscess drainage, exploration,...	463	503
Abdominal wall hernias	880	621
Gynecological procedures: hysterectomies, salpingectomy, oophorectomy, ovarian cystectomy, fibroids excision,...	848	493
Obstetrics: cesarian sections	20644	20368
Urology procedures: nephrectomy, ureter reimplantation, urethroplasty, pyeloplasty, cystoscopy, cystolithotomy, prostatectomy,...	474	564
Unlisted procedures	10458	10885

with distributions remaining relatively stable (Table 3).

ICU Admissions

The proportion of surgical patients requiring ICU admission decreased slightly from 0.9% pre-pandemic to 0.6% during the COVID-19 year. No significant difference was noted between country and district lockdown periods.

Length of Hospital Stay

The average hospital stay for surgical patients was 3.15 days during the COVID-19 year compared to 3.03 days pre-pandemic. Country lockdowns were associated with a minor increase in hospital stay (3.15 vs. 3.09 days), while district lockdowns resulted in a slight reduction (3.07 vs. 3.11 days) (Table S1).

Mortality and Transfers

Surgical patient mortality decreased from 0.66% pre-pandemic to 0.36% during the COVID-19 year. This trend was consistent during both country (0.33%) and district (0.27%) lockdowns. Transfers also declined, particularly from district hospitals, likely due to lockdown-related transport restrictions (Table S2).

Discussion

Contrary to our expectations, the number of outpatient and inpatient surgeries during the COVID-19 year did not significantly differ from the pre-COVID-19 period. This stability may be attributed to Rwanda's proactive response to the pandemic. The government implemented measures such as biweekly Cabinet meetings to adjust prevention strategies, prioritizing both containment and the continuity of essential services[7,8]. Hospitals received ongoing support, with health staff remaining on duty while other services shifted to remote work. Patients could continue to access medical services, and transfers between hospitals required COVID-19 testing[9]. The medical supply chain was maintained to address both routine and pandemic-related needs.

Despite these measures, COVID-19 affected surgical services. Reports showed an increase in emergency surgeries but a reduction in elective procedures, as expected during a pandemic[10]. Lockdowns, which restricted movement and heightened fears of infection, led to a decrease in both outpatient and inpatient surgeries. Patients avoided hospitals due to lockdown restrictions and high transport costs, leading to postponed or cancelled appointments[9,11,12].

Our analysis did not reveal any specific prioritization of surgeries during the COVID-19 period, although C-sections remained the most frequent surgery. Major surgeries continued as usual, but elective surgeries were generally deferred. Unlike some countries that used triage algorithms to prioritize surgeries, Rwandan hospitals adhered to a "first come, first served" policy, contributing to delays and backlogs.

ICU admissions for surgery patients were notably low during the pandemic. The redirection of ICU resources to COVID-19 care and limited ICU capacity likely contributed to this trend[13]. Rwanda's efforts to acquire more ventilators and establish referral centers aimed to mitigate these challenges[14]. Some studies suggest that lockdowns may have reduced trauma cases due to

decreased activities and transport, though results vary[15–17]. Reduced ICU admissions could also reflect stricter admission guidelines and efforts to avoid overcrowding and maintain quality care[18].

Patients tended to stay longer in hospitals during the COVID-19 period and country-wide lockdowns, but less so during district lockdowns. The difference in length of stay (LOS) was minimal, possibly due to additional COVID-19 protocols, staff shortages, and delays in discharge processes. Factors influencing LOS included hospital type, age, gender, and surgical specialty, with provincial and university hospitals having longer LOS compared to district hospitals.

Interhospital transfers decreased during the pandemic due to the risk of COVID-19 transmission and high costs. Transfers were primarily for accessing tertiary care, with a notable increase in transfers from district hospitals. Transfers were less common for emergency cases compared to elective ones, and the need for specialized care was a factor in transfer decisions.

Mortality rates among surgery patients decreased during the COVID-19 period and lockdowns. This reduction could be due to fewer critical injuries and enhanced infection control measures[19]. However, mortality rates remained higher in district hospitals and for specific age groups and specialties, such as neurosurgery and plastic surgery. Factors like high ASA scores and major surgeries also contributed to higher mortality rates.

The study has limitations, including its retrospective nature and missing data, which affected the analysis. There was a high number of uncategorised cases and it was difficult to ascertain whether certain subgroups of surgical cases disproportionately contributed to the observed findings. A prospective study could have provided more detailed covariate data, granularity of case categorization, pre-existing patient health statuses, and 30-day follow-up information for better outcome interpretation. Additionally, the dataset's dominance by obstetrics and gynecology cases may limit generalisability.

Overall, Rwanda's response to COVID-19, including strategic resource allocation and preventive measures, helped mitigate the pandemic's impact on surgical services. Despite the above-mentioned limitations, this study illustrates properly the resilience of surgical care in Rwanda during the COVID-19 pandemic. Notably, the volume of surgical outpatients and inpatients did not decrease, and patient outcomes did not worsen. This suggests that during a pandemic, measures such as lockdowns and mass immunization may positively influence the delivery of surgical patient care.

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GAIT statement[20] for Generative AI use: Generative AI was used solely for minor language editing in this manuscript. No content generation, data analysis, or substantive rewriting was performed. The authors take full responsibility for the accuracy and integrity of the work.

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