COVID-19 in Humanitarian and Fragile Contexts:

Disease surveillance, program monitoring, social interaction, and policy analysis during the first year of the COVID-19 pandemic

Democratic Republic of the Congo

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Acronyms

ACF	Action Contre La Faim
ANC1	Antenatal Care First Visit
ANC4	Antenatal Care Forth Visit
ARI	Acute Respiratory Infection
CAR	Central African Republic
CI	Confidence Interval
CFR	Case Fatality Rate
COVID-19	Coronavirus Disease 2019
DRC	Democratic Republic of Congo
DVDMT	District Vaccination Data Management Tool
FGD	Focus Group Discussion
GAM	Global Acute Malnutrition
GMP	Growth Monitoring and Promotion
HCWs	Health Care Workers
HH	Household
HZ	Health Zone
HWD	Hand Washing Device
IDP	Internally Displaced People
IPC	Infection and Prevention Control
IQR	Interquartile Range
IRR	Incidence Rate Ratio
ITS	Interrupted Time Series Analysis
LMICs	Low- And Middle-Income Countries
MAPEPI	*Maladies à Potentiel Epidemiologique* (Surveillance data)
MNCH	Maternal, Newborn and Child Health
NCDs	Non-Communicable Diseases
NGO	Non-Governmental Organization
OBGYN	Obstetric and Gynecology Care
OPD	Outpatient Department
PCR	Polymerase Chain Reaction test
PEP	Post-Exposure Prophylsubregion
PNC	Post-Natal Care
PPE	Personal Protective Equipment
RCCE	Risk Communication and Community Engagement
RH	Reproductive Health
RRT	Rapid Response Team
SAM	Severe Acute Malnutrition
SD	Standard Deviation
SGBV	Sexual and Gender-Based Violence
SNIS	*Système National d'Information Sanitaire (*National Health Information System)
SRH	Sexual and Reproductive Health
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

Executive summary

Background and objectives

The COVID-19 pandemic began in March 2020 and affected almost all countries in the world. Besides the direct effects of the spreading of the SARS-CoV-2 virus, particularly concerning was the capacity to maintain essential health services when resources and attention were focused on a single disease and diverted from routine health services. Health systems in low- and middle- income countries (LMICs) and in humanitarian settings were considered at highest risk at the beginning of the pandemic; however, such dire predictions did not occur. The objectives of this study are threefold: 1) to improve the understanding of the epidemiology of COVID-19 in the humanitarian setting of North Kivu, Democratic Republic of Congo (DRC); and 2) to analyze the broader impacts on essential health services and how such programs adapted; and 3) to learn how population behaviors related to health care seeking and social interactions were affected and changed over time. This study is part of a larger study implemented in three countries focusing on humanitarian settings: Bangladesh, Central African Republic (CAR) and DRC. It was led by the Center for Humanitarian Health at Johns Hopkins Bloomberg School of Public Health in collaboration the humanitarian organizations Action Contre la Faim (ACF) and IMPACT.

DRC is a low-income sub-Saharan African country with a young population. The main health issues include communicable disease, maternal, neonatal and nutritional diseases and has experienced many outbreaks in recent years, including reoccurring Ebola epidemics. The research site of the province of North Kivu has been the epicenter of conflict in the DRC over the past two decades and some of the most formidable challenges to stability in the country persist there today. Insecurity affects health service delivery and quality. Ill health is an enormous burden on households. Within two weeks of the first COVID-19 case detected on March 10, 2020, the DRC government quickly declared a state of emergency that included travel bans, widespread testing, lockdowns and quarantine. Lessons learned from previous experiences with Ebola informed the national response to COVID-19 in DRC. Similar to previous outbreaks, a multi-sectoral response coordination committee was set up and the main interventions were guided by a national pandemic preparedness and response plan for COVID-19.

Methods

This was a mixed-methods study that brings together primary and secondary, qualitative and quantitative data from a variety of sources. We aimed to complement health facility data with perspectives from both affected communities and health care workers (HCWs), to provide a more comprehensive understanding of the situation in the research site during the first year of the COVID-19 pandemic (March 2020 to March 2021). Each case study includes four components:

1) A descriptive epidemiological analysis of reported COVID-19 cases in North Kivu province, using the province COVID-19 line list.
2) An interrupted time series analysis assessing how health care utilization for a variety of services on the continuum of care has changed.
3) Perceptions of health service delivery adaptations through in-depth interviews with HCWs followed by qualitative analysis using thematic and framework analysis.

4) Health seeking behavior and social interactions following a mixed-methods approach of focus group discussions and a household survey. Qualitative data was analyzed using a saturation grid matrix. Quantitative data was analyzed using a weighted analysis of survey responses.

Key findings

1. COVID-19 epidemiology

- Epidemiology of COVID-19 cases aligned with global epidemiology, with the majority of cases among adults aged 18 to 50 years. Older age and male sex were risk factor associated with higher odds of mortality.
- Incidence rate was highest among people over 60 years of age (81.1/100,000); it was twice as high as in the 18-59 year group. Most COVID-19 cases were treated at home, and all hospitalizations occurred during the second wave (March 2021).
- The overall case fatality rate (CFR) was 11.1% and was similar between men and women. CFR was 29.2% among the elderly (60+ years) and 13.5% among 0–17 year olds. CFRs were likely overestimated due to the underestimation of cases.
- The largest number of deaths due to COVID-19 occurred in the first half of August 2020, and again between February and March 2021. This corresponds to the first and second waves of the COVID-19 in DRC.
- Testing rates increased dramatically in the last quarter of 2020, and the positivity rate was lowest during that same period compared to other months. The low number of testing and high positivity rate at the beginning of the first wave most likely indicated that many positive cases were missed.
- Testing capacity was initially available only in Goma (North Kivu's provincial capital), and slowly became available in more peripherical areas within the province.

2. Changes in health care utilization

Health areas within Mweso Health zone were aggregated into five subregions along the 5 supervision subregions used by health actors.

- **OPD consultations**: there was a consistent and immediate increase in all subregions, although results were statistically significant in two only. The trends during COVID-19 did not seem to differ from pre-COVID-19 trends. High variations before COVID-19 led to an unstable model fit.
- **Maternal health services** (antenatal, deliveries, postnatal care): except for mixed results for ANC1, all other maternal health services reported an increase in all subregions.
- **Consultations for infectious diseases** (malaria, diarrhea with dehydration, mild pneumonia): mixed results occurred within the health zone. When an increase was reported, it was mainly due to an increasing trend during the COVID-19 period rather than immediate change.
- **Measles cases**: in 50% of the health areas, the average number of cases per week increased during the COVID-19 period. Most of the health areas reported many more suspected measles cases during the COVID-19 period than before.
- **Cholera cases**: the majority of health areas report lower average weekly numbers of cholera cases during the COVID-19 period than before the pandemic; the highest number of cases occurred in 2018.

- **Measles vaccination**: all subregions reported a decrease in the number of vaccine doses delivered during the COVID-19 period than before the pandemic.

3. Health care workers perceptions

- Most HCWs reported a decrease in reproductive health, maternal and newborn health, and child health services.
- Results were mixed for child nutrition services and hospital based care with about half of respondents saying there was no change while others reported a decrease in services.
- The only areas where there was no perceived change were referrals, laboratory services, and care for sexual and gender-based violence.
- Community outreach services were reported as reduced or stopped altogether.
- Non-communicable disease services were momentarily suspended in the centers that offered these services.
- Drug availability was decreased as reported unanimously by all HCWs.
- Infection, prevention and control (IPC) measures were implemented in the majority of the health facilities, but stockouts and limited access to water represented a challenge to IPC. HCWs reported negative attitudes of the population towards IPC measures.

4. COVID-19 knowledge, health care seeking behaviors and social interactions

Knowledge and reported practice of preventative measures

- All respondents were aware of COVID-19.
  - Good understanding of risks of contracting COVID-19.
  - Low understanding of who is most susceptible.
  - Elderly were less well informed.
  - No significant difference based on sex, displacement status or rural/urban.
- Concept of asymptomatic cases not well understood.
- Knowledge of reported measures to prevent COVID-19 were correct: wearing a mask, hand washing, reduce contact, and physical distancing.
- Reported practice was not high: only half of the respondent report wearing a mask and less than half are maintaining physical distance.
  - Displaced people had the most trouble maintaining physical distance.
  - Handwashing practices were fairly high – less women, urban and people at risk practiced this measure. It was said to be the most applied because it protects against several other disease and not because of COVID-19.
- Behavior change was motivated by avoiding law enforcement and fines and avoiding COVID-19.
- Practices decreased over time.
- Access to protective measures such as soap and masks was limited by supply and financial barriers.
- Impact on daily life was significant due to closures and movement restrictions.

Information sources

- Radio was the most common source of information and considered the most reliable, followed by information from health workers in health facilities.

    - The elderly and women relied more on their surroundings and community/religious leaders for information than others.
    - People living in rural areas relied on the radio less and accessed slightly more information from health facilities.
- All groups expressed facing obstacles in accessing reliable information on the pandemic and prevention measures primarily due to poverty and lack of resources to buy a radio or telephone.
- Rumors about how to prevent COVID-19 were reportedly not common nor put into practice. However, rumors as to how to treat COVID-19 were common, such as drinking local and strong alcoholic beverages (e.g., rutuku), consulting traditional practitioners, and putting a hair in the water to drink.

Vaccination

- Half of the respondents were willing to get vaccinated against COVID-19.
    - More men than women; no difference among age groups; rural populations more willing than urban.
- Reasons given for not willing to get vaccinated were:
    - Need for more information about the vaccine and possible side effects.
    - Rumors such as the vaccine can kill people, could control the body, is satanic, can disable, or can cause the body to bloat.

Health care seeking behaviors: in general, and during the first months of COVID-19

- Most respondents reported seeking treatment or advice.
    - Men and displaced persons sought care less than other groups, and there was geographical variation.
- The biggest barrier to seeking care was finances, while lack of facilities and drugs was also an issue; trust did not seem to be an issue.
- Health centers were the most common place for treatment.
    - Rural residents and women preferred health centers the most.
    - There waw geographic disparity.
- Health care seeking behaviors did not change at the beginning of the pandemic; almost all respondents sought assistance when they felt sick with no gender or displacement-based variations. However, persons at risk sought care less frequently than others.
- Health centers continued to be the most common place for seeking care.
    - Natural medicines, mobile clinics, and private doctors were uncommon responses.
    - Displaced people sought care more frequently from natural healers.
- Routine vaccinations were not interrupted.
    - A quarter of those who did not vaccinate their children cited fear of COVID-19 infection; concern was more common among men and urban populations.

Social Interactions

- All groups reported the number of people residing in their households was higher during the pandemic because of the closure of schools and work.
- Most people reported a decrease in frequency and duration of meetings during the months of COVID-19 restrictions (March to August 2020); 1 in 4 people did not report any change to their social interactions.

- Most people worried about social interactions, but these interactions were perceived as inevitable. However, half of the people reported meeting others for leisure. The elderly were avoided so as not to transmit COVID-19 to them.
- Most people reported daily interactions.
    - Most respondents had 1-2 interactions per day, mostly with a friend in a home setting or household member.
    - Interactions were short (15min -1 hour).
    - Interactions included physical contact.
    - Most respondents report no one in the interaction to be wearing a mask.

Access to WASH

- Access to handwashing devices increased during the pandemic, yet over half of the respondents did not have access to a functional handwashing device, and less than a third had a functional device at home.
    - The elderly and disabled had the least access.
    - Rural populations and boys/men had less access than urban and girls/women.
    - Access to WASH varied depending on geographic area.
- Most respondents reported washing their hands more often during the pandemic, although persons at risk and the elderly showed less change in behavior.
- Washing hands was reported as common because it protects from other disease (such as diarrhea and cholera) and not because of COVID-19.
- Greatest challenge to accessing a functional handwashing device was prohibitive cost of soap or water, especially for displaced and rural respondents. Distance to water point was an additional challenge for the elderly.

Key recommendations

1. Policies and their implementation

The DRC benefited from lessons learned from the multiple Ebola outbreaks in the country. Response measures were instituted including travel bans, widespread testing, quarantine, and community-based contact tracing. However, localized support was insufficient to address a disease that spread as quickly and widely as COVID-19 compared to Ebola. An after action review as to how best to integrate a pillar response structure into the provincial health systems for diseases according to their different characteristics, taking into account aspects such as the reduction of external support and funding due to the pandemic as well as insecurity in settings like North Kivu, should be undertaken.

The main barrier in accessing health care was reported by the community not to be COVID-19, but rather financial barriers. Health care provision and costs in the Kivus depend upon external technical and financial partners and their policies. While free health care for previous Ebola outbreaks was shown to increase access to care, it was not introduced as part of the COVID-19 pandemic response, likely due to the spread of COVID-19 compared to Ebola and the reduced external support. Until systemic barriers are addressed, and universal health care achieved, short term solutions will only temporally improve health access and outcome of DRC populations.

While the study aimed to investigate fluctuations in health care utilization in Mweso in relation to the COVID-19 pandemic, the security situation was likely a major factor affecting utilization and

community outreach. Health utilization rates may, therefore, show erratic or unexpected patterns as people access care during periods of relative calm, maintaining quite high coverage of schedulable interventions. It was more problematic in accessing care for acute emergencies, as population movements were limited. Therefore, the initiation of disease-specific policies and their implementation in areas of conflict and insecurity need further reflection as to their direct and indirect consequences. Furthermore, interpretation of data must be made cautiously due to the complex interactions between responses due to disease prevention and control measures combined with insecurity.

2. Diseases testing capacity and strategies

Ensure testing capacity for COVID-19 and future diseases of epidemic potential is quickly scaled-up at the beginning of an epidemic in DRC to better understand the epidemiology of the disease.

If such rapid scale-up of testing is not possible, use a limited number of tests to undertake representative sample of tests to improve initial understanding of disease epidemiology and CFRs. For the latter, this may allay anxiety and encourage positive health seeking behavior if the population has a more realistic understanding of the mortality of the specific disease. It could also help build trust amongst the community and government authorities, which was noted as a barrier regarding understanding and positive health seeking behaviors.

As soon as feasible, undertake a population-based antibody serosurvey to improve the understanding of the epidemic and to allow for more informed policies and programs.

3. Health systems data management

Routine health services: Ensure continuity and transparency of reporting to avoid perceptions of service interruptions. Although the health systems data were not always consistent across the subregions, HCWs' perceptions that services were interrupted were not always supported by the health systems data. Real time contextual analysis of the data according to specific events in the health zones (e.g., implementation of specific policies such as isolation or quarantine, insecurity that could restrict people's movement) is needed to better interpret data. For example, the reported CFR was high (11%), and much higher than the estimated 2.6% CFR at the country level. While the CFR may be overestimated due to many cases going unreported, the increasing of cases coincided with the strike of HCWs involved in the response to COVID-19. In addition, oxygen capacity was limited and emergency services in remote areas of North Kivu were not easily accessible, increasing the risk of mortality for severe cases. Contextual analysis would help disentangle the various interacting elements and allow for improved interpretation of the situation.

COVID-19: Ensure clinical characteristics of cases are included in the line list to better understand epidemiology of the disease. Ensuring the line list is complete and up to date is also key.

4. Data from the community, and risk communication and community engagement

This study included a great deal of data from community members, including social interactions and knowledge, attitudes and practices. Numerous issues were documented, such as lack of trust amongst the community of authorities, and differences between knowledge and practice. Attitudes toward the government and trust in its capacity to respond to the pandemic may have played a larger role than mandates, possibly undermining potential effects of the latter. Data from the community showed mistrust of the new COVID-19 vaccine that affected the trial of an Ebola vaccine conducted early 2020, and reignited controversy about vaccine research, post-colonial exploitation, and the interests of Western pharma-capitalism. Some IDPs in North Kivu advocated for long terms solutions, such as peace in the region, pointing to how they would be able to implement physical distancing if they were home. Acknowledging to the community that while short term solutions for some preventative measures are needed now, the importance of longer term solutions, particularly peace and the return to their homes, is an important aspect that should not be ignored. In the future, community surveys should be powered, if feasible, to disaggregate according to displacement status as their knowledge, attitudes and practices may be different than non-displaced persons.

Community members seem to have attached more importance to hand washing than masking and other preventative measures, possibly due to previous exposure of WASH and health activities aimed to respond to multiple outbreaks such as Ebola and cholera in recent years. This is a positive finding that suggests that while behavior change does take time, it can be achieved. Consequently, a sustained focus on specific issues (e.g., COVID-19 vaccine acceptance) should also include other diseases and measures already present in DRC (e.g., childhood vaccinations) that can also reduce the risk of conflicting messages.

Furthermore, more social interaction surveys in fragile and conflict-affected contexts need to be undertaken to support RCCE as well as service delivery in future epidemics. More studies are needed to examine the potential biases from telephone surveys compared with in-persons surveys.

The DRC has an 'Integrated Analytics Cell' (called CASS in DRC) that uses multidisciplinary and integrated analysis to better understand and respond to epidemics. Findings from this study can be used to inform, support and complement the work of this group, including the implementation of qualitative and quantitative methods from the community (including with a focus on HCWs) as well as 'data scraping' from the web and social media to understand communities' knowledge, attitudes and practices. As with health system data, community data need to be disaggregated according to the above-mentioned factors and repeated over time to understand trends. These data are essential to inform health service and RCCE strategies and services.

RCCE programs need to be adapted according to data and evidence collected. Data showed that knowledge about the disease and transmission pathway was high among adults in Mweso health zone; the concept of asymptomatic case and who is most at risk was, on the contrary, not well understood. Further investigation on the rural/ urban and displaced/ non-displaced divides is warranted to understand why this may be and how to correct it by trying to better target hard to reach populations. The concept of asymptomatic cases may require particular attention in RCCE messages. Finally, the success of the communication and awareness activities in RCCE is also dependent upon the need to address the structural and financial barriers as mentioned in the policy recommendations above.

5. **Health care access and utilization**

There is a need to improve the understanding of health care access and utilization during the COVID-19 epidemic in DRC. The ITS data showed an increase in overall OPD consultations and for maternal health services, with a decrease in childhood vaccinations. The reduction in measles vaccination was accompanied with an important increase in measles cases over the same period.

Further investigation into consultations for infectious diseases should occur to better understand health seeking behavior as results were inconclusive. The analysis must include qualitative and quantitative studies to better understand changes in health provision and quality of services as well as community perceptions. As mentioned above, the need for contextual analysis, including a political economy analysis, will improve understanding and interpretation of the results. Such an analysis will allow for improved preventative and curative health service and RCCE programs during the current outbreak as well as for future epidemics.

6. **Data triangulation**

Our study shows the need to triangulate disease specific data, health systems data, and community-based data is essential for analysis and interpretation to inform strategies and programs. This is also an objective of CASS, mentioned above.

1 Introduction

The COVID-19 pandemic declared by the World Health Organization (WHO) on March 20, 2020, has affected almost all countries in the world and all aspects of our societies. With more than 643.5 million cases and 6.6 million deaths by December 1, 2022 [1], the COVID-19 pandemic has challenged every health system in the world and led to a variety of governmental responses that aimed to both contain the spread of the disease, maintain essential services, and overall trying to minimize disruptions while protecting their populations.

Since the identification of the novel SARS-CoV-2 virus in December 2019, extraordinary progress has been made in terms of understanding how the virus operates in the human body, transmission chains, risk factors for negative outcomes up to the development, treatment strategies and production at scale of multiple effective vaccines. Effects on countries, economies and communities varied across regions and over time, as multiple waves of cases were recorded at different times in different parts of the world.

Health systems in low- and middle-income countries (LMICs) and in humanitarian settings were considered at highest risk at the beginning of the pandemic due to both very low capacity to prepare and respond to epidemics and pandemics [2] and pre-existing vulnerabilities ranging from already fragile, understaffed, and underfunded health systems, limited available emergency care capacity, poor living conditions, limited access to water and sanitation, potentially vulnerable population with precarious health status. [3, 4] Several modeling studies attempted to estimate the burden of infections in various LMICs and forced displacement settings in Africa and worldwide, depicting quite gloomy scenarios. [5, 6] Fortunately, these dire forecasts did not occur, although several waves have been reported in all countries. 20 million cases and 389,000 deaths were reported in LMICs hosting humanitarian settings by Nov 30, 2022, [7] with most cases being asymptomatic and a low proportion of patients experiencing severe outcomes and death. [8, 9] The underlying causes for the heterogeneity in the disease spread in different countries remain unclear. Several factors have likely contributed to such different scenarios including early introduction of response measures, previous experience with epidemics and emergencies, demographic factors, host genetics and cross reactivity with other pathogens, climate and environmental factors. [9, 10]

Besides the direct effects of the spreading of the SARS-CoV-2 virus, particularly concerning was the capacity to maintain essential health services when resources and attention were focused on a single disease and diverted from routine health services. In previous large-scale epidemics (e.g., Ebola in West Africa and Cholera in Yemen), there was excess morbidity and mortality from communicable and non-communicable diseases (NCDs). [11] National governments and humanitarian organizations implementing health programs quickly recognized the need to adapt service provision in order to minimize infections while ensuring the service could be continued. [12] Without existing guidance, program adaptations were introduced, piloted and adapted, which in turn informed the development of guidance. [13]

Despite the increasing evidence, less is known about COVID-19 in humanitarian settings, both in terms of epidemiology, broader impacts on essential health services, how programs have been adapted and how population behaviors related to health care seeking and social interactions have been affected and have changed over time. Therefore, we designed a multi-country study implemented in three countries focusing on humanitarian settings: Bangladesh, Central African Republic (CAR) and Democratic Republic of Congo (DRC). The study covered the first year of the COVID-19 pandemic at

which time more than 126.4 million cases and 2.8 million deaths were recorded globally by the end of the study period (March 31, 2021) [14] (data as of March 28, 2021). The study had the following objectives: .

1. Improve the understanding COVID-19 epidemiology in humanitarian settings
2. Assess the broader impact of the pandemic on non-COVID-19 morbidity and mortality, as well as on health services utilization by vulnerable groups.
3. Investigate how social interaction and health seeking behaviors have been affected and evolved during the pandemic.
4. Document policies and interventions and investigate their impact on the epidemiology of COVID-19 and non-COVID-19 diseases.

This report focuses on DRC and presents the methodology, findings, and discussion of the study. The study was led by the Center for Humanitarian Health at Johns Hopkins Bloomberg School of Public Health in collaboration with Action Contre la Faim (ACF) and REACH, two humanitarian organizations who have been present in the three countries for many years. ACF facilitated processes to obtain secondary data from the Ministry of Health (MoH), including COVID-19 line list and routine health services. ACF also conducted key informant interviews with HCWs. REACH led the primary qualitative and quantitative data collection, by conducting focus group discussions and a household survey in the communities living in Mweso health zone.

2 Case study profile

2.1 Mweso Health Zone, North Kivu, DRC

DRC is a low-income sub-Saharan African country with 86,790,568 population in 2019 according to the World Bank, and gross domestic product estimated at 50.4 billion US dollar. The life expectancy from birth was 60.7 years [15] The majority (65%) of the population is under 24 years of age and only 2.5% is over 65 years of age. [16] Main health issues include communicable disease, maternal, neonatal and nutritional diseases. Malaria, tuberculosis and lower respiratory infections remain the main cause of deaths in DRC.

DRC has experienced many outbreaks in recent years. The 13th Ebola epidemic was declared in North-Kivu October 2021, the second in the same year and in the same area as the 2018 one that lasted two years. It was only by December 16th, 2021, that the authorities declared this Ebola epidemic over. Given the weak health system and the challenges related to pre-existing health issues in African countries, it is understandable that COVID-19 could aggravate the situation in these countries.

The research site for this analysis is Mweso health zone (HZ) within the Masisi territory in the North Kivu province of DRC (figure 1). North Kivu has been the epicenter of war in the DRC with over two dozen armed groups emerging over the past two decades. Some of the most formidable challenges to stability in the country persist here today. [17] Insecurity has resulted in both cross-border refugee movement and internally displaced people (IDPs) and ongoing insecurity hampers the delivery of humanitarian assistance. Insecurity affects health service delivery and quality through 3 main pathways: violence, mobility restrictions, and resources availability. [18]

North Kivu Province has 27 health zones (*zones de santé*) organized around the general referral hospital in Goma. As elsewhere in the DRC, health structures are weak, resources are limited, health workers have often received limited training and the quality of care is generally low. It is difficult for the population to access care due to both financial and non-financial barriers (including distance from household to point of service delivery and insecurity). There is a lack of essential drugs and a reliance on informal user fees to help cover staff salaries, operational costs, and health zone management. The ongoing conflict has had a detrimental impact on access to healthcare, and the health system is fragmented and politicized with recent attacks reported on pharmacies and hospitals. [19] Of several mediating factors that play a role in service delivery and quality, the 2 most important are health care workforce availability and drug/equipment accessibility. [18]

Ill health is an enormous burden on households. Households in North Kivu would expect to lose between a quarter and a third of their annual income because of sickness, either to pay for accessing healthcare and other related expenditure, or from an inability to work because of being sick or caring for a patient. These estimates are conservative, as they exclude cases with the highest costs for more serious illness. [20] Rates of episodes of ill-health are high, with the majority of people seeking care at health centers.

The Mweso health zone has been chosen as case study because it has been particularly affected by insecurity during the last decades and for the operational presence of ACF.

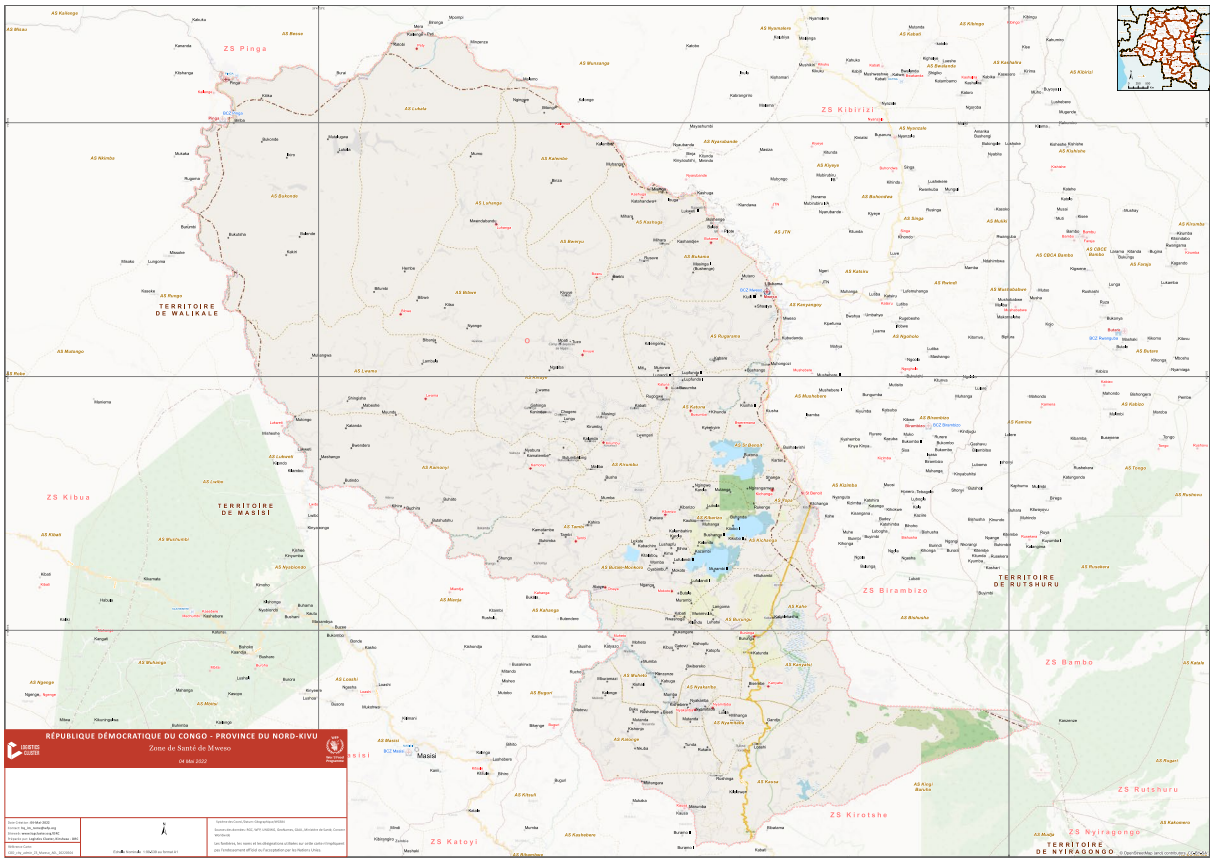

Figure 1: Administrative map of the Mweso health zone in the North-Kivu province

2.2 COVID-19 response measures

Lessons learned from experience with Ebola informed the national response to COVID-19 in DRC. Prior to the first case of COVID-19 detected in DRC, the DRC MoH with support from WHO began preparing the country for a possible importation of COVID-19 cases. The WHO country office therefore relocated a large number of its multidisciplinary team (epidemiologists, logisticians, data managers, infection prevention and control experts, etc.) from the North Kivu Ebola response to Kinshasa to support the preparation. The capacity of a 61-person multidisciplinary rapid response team (RRT) in three provinces (Kinshasa, Kongo Central and Kwango) has been strengthened. [21]

The first confirmed case of COVID-19 in DRC was reported on March 10, 2020 (with the first case in North Kivu recorded on March 27, 2020). Similarly to previous outbreaks, a response coordination committee was set up under the President's office by the government and the WHO to fight the COVID-19 outbreak in DRC. [21] This was a multi-sectorial committee with a task force under the coordination of President's Office. The main interventions of the response were guided by a national pandemic preparedness and response plan for COVID-19 with a total budget of US dollar 135 million. The COVID-19 response plan included different pillars such as coordination, epidemiological surveillance, health control at entry points, case management, testing policy, infection prevention and control, logistics, risk communication and community engagement to guide the response actions.

Rapidly within two weeks of the first case detected, DRC government declared a state of emergency that included travel bans, lockdowns, widespread testing, and quarantine. The municipality of La Gombe, considered as the epicenter of the COVID-19 outbreak in the city of Kinshasa, was concerned

by the lockdown in April 2020. All movements by public transport, buses, trucks, and other vehicles from the interior to the Capital and from the Capital to the interior were prohibited. At the national level, travel bans were imposed and all flights from at-risk countries and transit countries were suspended, and also maritime, river, lake and land entry posts of the territory were concerned by the ban. Only aircraft and cargo ships and other means of transport cargo were allowed access to the territory and their personnel underwent systematic health controls. People presenting with COVID-19 symptoms and likely to be affected by COVID-19 were placed in quarantine of up to 14 days. Closure over the entire national territory of schools, universities, official and private higher institutes and all institutions receiving the public as well as meeting places was ordered for four weeks. Nightclubs, bars, cafes, terraces and restaurants closed. All religious services and sports activities in stadiums and other places of sports gathering were suspended for a period of 30 days from March 19, 2020. At the same time, the Government tried to identify ways and means to increase the capacity of hospitals, with pavilions specially dedicated to people with COVID-19 and holding private hospitals ready to intervene in the event of a worsening situation. However, poverty and livelihood constraints considerably limited the compliance with such measures. Furthermore, masks and hand washing facilities remained insufficient. Gradually, cases of COVID-19 were reported in other provinces. In August 2020, pupils and students resumed classes. Churches, bars, shops and festive places have gradually opened. The response measures have been regularly readjusted to the context with varying degrees of effectiveness. They were relaxed outside of epidemic peaks and reinforced at the time of the waves. Figure 2 shows the Containment and Health index during the study period for DRC. [22, 23] This index combines 'lockdown' restrictions and closures with measures such as testing policy and contact tracing, short term investment in healthcare, as well investments in vaccines, and gives an idea of the number and strictness of measures in place over time. It ranges from 0 to 100, with 100 being the strictest level. It does not assess the appropriateness or effectiveness of a country's response.

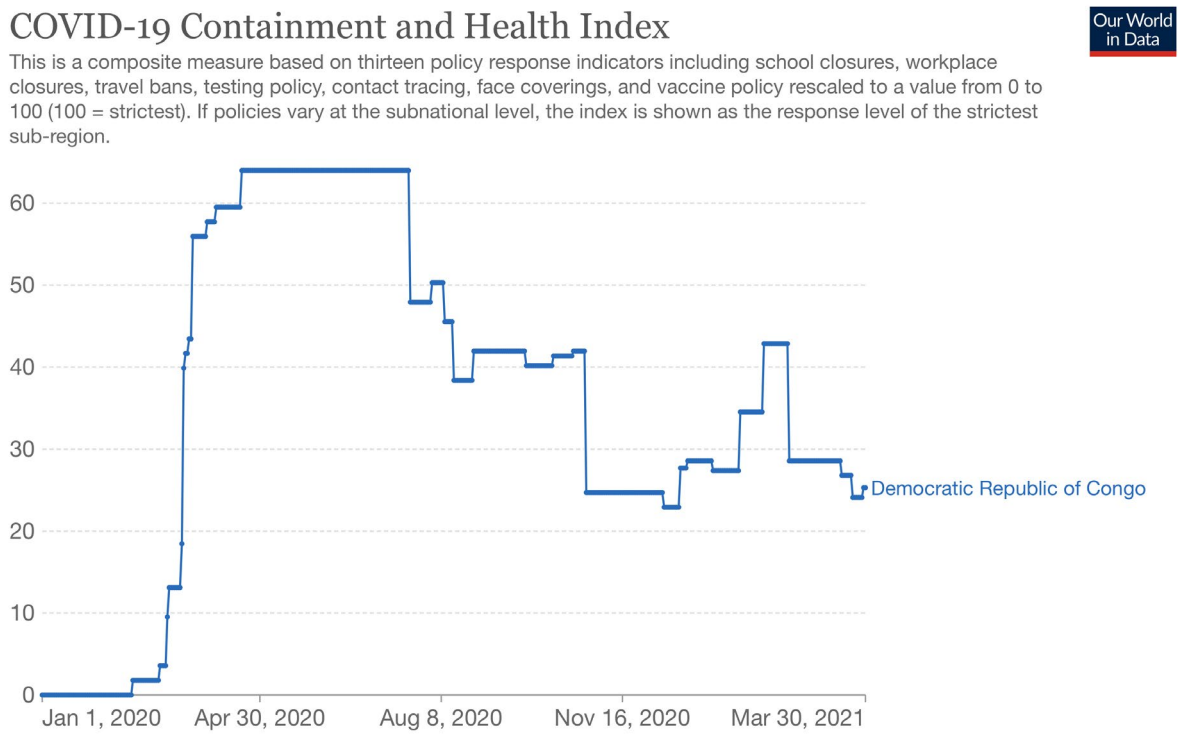

Figure 2: Containment and health index, March 2020 to March 2021, DRC

3 Case study methodology

3.1 Overview of study components

This was a mixed-methods study that brings together primary and secondary, qualitative and quantitative data from a variety of sources. We aimed to complement health facility data with perspectives from both affected communities and health care workers (HCWs) to provide a more comprehensive understanding of the situation in the research site.

Each case study includes four components:

1. COVID-19 Epidemiology.
2. Changes in health care utilization.
3. Perceptions of HCWs on health service delivery adaptations.
4. Health seeking behavior and social interactions.

While the approach is consistent across case studies, adaptations were necessary to reflect data availability and contextual and cultural differences.

3.2 Ethical approval and national authorizations

Ethical approval was obtained from the Johns Hopkins Bloomberg School of Public Health's Institutional Review Board (IRB). Components 1 to 3 were deemed non-human subject research (IRB determination notice 14719) as they used only secondary, aggregated, or anonymized quantitative data; and qualitative interviews with HCWs were conducted in their professional capacity. Authorization to access and analyze data was obtained from the Ethical committee of the School of Public Health of the University of Kinshasa (Letter ESP/CE/175/2020). Component 4 was deemed human subject research (JHSPH's IRB determination note 15447) as personal information was collected. The research was approved by the IRB of the University of Bukavu (Letter UCB/CIES/NC/005/2021). Participation in the surveys and focus group discussions was voluntary and only consenting adult respondents were included.

3.3 COVID-19 epidemiology

3.3.1 Objectives

This component aimed to investigate the epidemiology of COVID-19 in DRC. It was a descriptive epidemiological study using existing COVID-19 data from the provincial branch of the national response committee.

3.3.2 Data sources

A COVID-19 line list was compiled at provincial level (North Kivu) and includes all confirmed cases of COVID-19 between March 27, 2020 and March 31, 2021 in North Kivu, DRC. Following anonymized individual information are included:

- Patient demographic information (age, sex, nationality, profession).
- Geographical information: health area, health district.
- Test data (dates of sample collection, test, reason for testing).

- Exposure risks (travels, contact with a confirmed case).
- Case management: hospital status, site of treatment, date of discharge.
- Outcome of disease (recovery or death).

Testing data were also obtained and included weekly number of tests conducted and test results in North Kivu from June 2020. Furthermore, data on the number of tests and cases at national level were obtained from Johns Hopkins COVID-19 resource Center [1] and Our World in Data [24].

3.3.3 Analysis

Prior to the analysis, we cleaned the dataset and created variables (for example, outcome, travel) using information available in the dataset and we checked the completeness of information in the dataset. Statistical analyses were performed using Stata® software. [25] Quantitative variables were presented as mean ± standard deviation (sd) or median and Interquartile range (IQR). Categorical variables were expressed in frequency. We used the independent Student's t test or one-way analysis of variance (ANOVA) for comparison between 2 or more groups respectively. For comparisons of categorical variables, Chi-square and Fisher test (F) were calculated according to the number in each box. We performed a multivariate logistic regression to determine the factors associated to disease outcome (death or recovery). We considered p-values less than 0.05 as statistically significant.

3.4 Routine health services

3.4.1 Objectives

This component aimed to estimate how health care utilization changed at the beginning of the COVID-19 pandemic and over time during the first year of the COVID-19 pandemic.

3.4.2 Data sources and data collection

Three sources of data were used:

1. The National Health Information System (*Système National d'Information Sanitaire* - SNIS), from which we obtained number of new outpatient consultations; number of consultations for suspected malaria; number of consultations for diarrhea with dehydration; number of first and fourth antenatal care visits; number of third postnatal care consultations; number of institutional deliveries and measles vaccination coverage.
2. The District Vaccination Data Management Tool (DVDMT), from which we obtained data on measles vaccination.
3. Surveillance data (*Maladies à Potentiel Epidemiologique* - MAPEPI), from which we obtained the number of suspected measles and cholera cases.

SNIS and DVDMT record data on monthly basis. MAPEPI provides data on weekly basis. Data are provided at health area level, which are subdivisions within a given health zone, usually covering between 5,000 and 10,000 people via one health center offering the basic health service package as per national strategy. Mweso health zone is subdivided into 22 health areas that have been included in the analysis. The study covers the period from January 2017 to March 2021.

The definitions of the indicators included in the analysis are presented in table 1.

Table 1: Definitions of indicators

Indicator	Numerator	Denominator
Health utilization rate	Number of new consultations, per month	Population in catchment area, divided by 12
Rate of consultations for malaria	Number of suspected malaria cases, per month	Population in catchment area, divided by 12
Rate of consultations for diarrhea with dehydration	Number of cases of diarrhea with dehydration, per month	Population in catchment area, divided by 12
Antenatal Care 1 coverage (ANC1)	Number of ANC1 visits, per month	Number of estimated pregnant people in a year, divided by 12
Antenatal Care 4 coverage (ANC4)	Number of ANC4 visits, per month	Number of live births in a year, divided by 12
Coverage of third postnatal care consultation (PNC3)	Number of PNC3, per month	Number of live births in a year, divided by 12
Institutional deliveries coverage	Number of institutional deliveries, per month	Number of live births in a year, divided by 12
Measles vaccine coverage	Number of measles-containing vaccine doses administered to children 0 – 11 months old. This includes doses administered via fixed, mobile, and advanced vaccination strategies.	Population 0 – 11 months old in catchment area, divided by 12
Number of measles cases	Number of measles cases, weekly	
Number of cholera case	Number of cholera cases, weekly	
Rate of consultations for mild pneumonia	Number of mild pneumonia cases, weekly	Population in catchment area, divided by 12

3.4.3 Analysis

We organized the 22 health areas from the Mweso health zone along the 5 supervision subregions used by health actors. These are: Central, Kitshanga, Mokoto, Kirumbu, Bibwe. We assume that the health areas located in the same supervision subregion share some common characteristics, including seasonality and changes during the COVID-19 period (whether they be due to COVID-19, its consequences, or any mitigation measures or policies). The location of health areas by subregion, as well as 2017 population and estimates of pregnant people and children under 5, are presented in Table 2.

Table 2: List of Health areas by subregion, population size and live births

Subregion	Health area	Population size (2017)	Estimated number of live births (2017)
Bibwe	Bibwe	27,570	1,268
	Bweru	12,202	561
	Kivuye	16,863	776
	Luhanga	7,200	331
Central	Bukama	15,299	704
	Bushanga	22,077	1,016
	Kalembe	21,661	996
	Kashuga	21,085	970
	Rugarama	20,921	962
Kirumbu	Busumba	16,968	781
	Kamonyi	16,150	743
	Katuna	11,566	532
	Kirumbu	25,375	1,167
	Lwama	10,285	473
Kitshanga	Burungu	22,305	1,026
	Kichanga	37,138	1,708
	Mwanja	7,421	341
	St Benoit	36,632	1,685
	Yopa	14,252	656
Mokoto	Kibarizo	15,557	716
	Mokoto	13,506	621
	Tambi	15,858	729

Exclusion criteria

For each indicator, we first removed outliers from pre-COVID-19 period, defined as any observations that were at least 3 standard deviations away from the pre-COVID-19 mean. After removal of outliers, we excluded health areas with less than 36 months of pre-COVID-19 data (i.e., with max 25% of pre-COVID-19 period data missing), and with less than 3 months of data recorded in the COVID-19 period. The number of health areas retained for each indicator included in the ITS analysis is provided in Table 3.

Table 3: Number of health areas included in the analysis by outcome indicator

Indicator	Subregion				
	Bibwe	Central	Kirumbu	Kitshanga	Mokoto
New consultations	4	5	5	5	3
Malaria	4	5	5	5	3
Diarrhea with dehydration	2	4	3	2	0
ANC1	4	5	5	5	3
ANC4	3	5	4	5	3
Deliveries	3	5	5	4	3
PNC3	3	4	3	4	2
Measles coverage	4	5	5	5	3
Mild pneumonia	4	5	5	5	3

3.4.3.1 Interrupted time series

For each subregion, we fit the following mixed model:

$$Y_{ij} = Negative\ Binomial\ (\mu_{ij})$$

$$\mu_{ij} = offset(\log(population)) + \gamma_1 COVID\ period + \gamma_2 COVID\ month + s(Calendar\ month, bs = \text{"cc"}, k = 12) + s(harea, Centered\ month, bs = \text{"re"}) + s(harea, bs = \text{"re"}) + \epsilon_{ij}$$

Where:

- Y_{ij} is the indicator of interest in health area j in month *i*;
- $bs = \text{"re"}$ indicates a random effect term at health area level,
- $s(Calendar\ month, bs = \text{"cc"}, k = 12)$ captures seasonality (shared at the subregion level),
- $s(harea, Centered\ month, bs = \text{"re"})$ captures health-area specific longer-term trend, modeled as a random effect, and
- $s(harea, bs = \text{"re"})$ captures random intercept for each health area in the subregion.
- s indicates a smoother term.

The model was fit as a generalized additive model with AR1 correlation, using *mgcv* package in R. [26] For indicators with known or anticipated seasonality, such as new consultations, suspected malaria consultations, and diarrhea with dehydration, we fit a model with the seasonality term as described above. For other indicators, where seasonality was not expected, we did not include this term. We consider COVID-19 period to be from April 1, 2020 to March 31, 2021, and the period from January 2017 through March 2020 to be "pre-COVID-19 period."

As sensitivity analysis, we considered a model allowing for variation of trends at health area each year of the study period. This model takes the following form:

$$Y_{ij} = Negative\ Binomial\ (\mu_{ij})$$

$$\mu_{ij} = offset(\log(population)) + \gamma_1 COVID\ period + \gamma_2 COVID\ month + s(Calendar\ month, bs = \text{"cc"}, k = 12) + s(harea, Centered\ month, bs = \text{"re"}) + s(harea, bs = \text{"re"}) + \text{s(harea, month\_2017, bs=}re\text{)} + \text{s(harea, month\_2018, bs=re)} + s(harea, month\_2019, bs = re) + s(harea, month\_2020, bs = re) + \epsilon_{ij}$$

Results of the sensitivity analysis are provided in the supplementary material (annex 4).

Note that for measles and cholera cases, the occurrence of cases was too sporadic to carry out ITS. Instead, we limited the analysis to looking at average number of cases prior to beginning of the COVID-19 period and during COVID-19 period, as well as plotting the time series for each of the two indicators.

3.4.3.2 Difference from expected values

A number of steps were required to estimate the difference between observed and expected cases:

- To estimate the counterfactual, or expected values during COVID-19 period, we first generated the expected value and standard error for each of the months in COVID-19 period using the fitted model, setting $COVID\ perioa$ and $COVID\ perioa$ to 0. We then drew 1,000 draws from a normal distribution with these parameters for each of the months in the study period.
- Prior to estimating difference between observed and counterfactual values, we imputed missing observed values. To do so, if a value was missing, we drew 1,000 draws from a normal

distribution with parameters from the fitted model. If the value was not missing, then we used the observed value.

- To estimate cumulative difference for each subregion, we calculated the difference between observed and counterfactual value for each month for each health area and summed them across the entire COVID-19 period.
- To calculate monthly percent difference, for each of the 1,000 draws, we estimated the counterfactual cumulative number of consultations for each month, as well as the cumulative number of observed consultations for each month of the same period. We calculated percent difference between observed and counterfactual values for each month. To estimate median and 95% intervals for percent difference during COVID-19 period, across 1,000 draws, we obtained the median and lower and upper bounds of monthly percent differences by obtaining the 50th, 2.5th, and 97.5th quintiles for each month of the COVID-19 period.

3.5 Health care workers' perceptions

3.5.1 Objectives

This component aimed to understand how health service provision was modified since the beginning of the COVID-19 pandemic, to gather perceptions and opinions of HCWs about adaptations, measures, changes in consultations, as well as their understanding of the population's perceptions.

3.5.2 Data sources

In-depth interviews with healthcare professionals were conducted between March and June 2020. Thirteen health facilities were visited (9 health centers, 2 referral health centers, 1 health post and 1 hospital) in the Mweso health zone in North Kivu. Different types of healthcare professionals were interviewed to capture a variety of perspectives, though the final sample ultimately depended on the availability of specific healthcare professional profiles at a given health facility the day that health facility was visited. Interviews were conducted and recorded in French. An interview guide was developed for each profile (Annex 1).

3.5.3 Analysis

Transcripts or notes for each interview were drafted in French and thematic analysis was conducted. Framework analysis was used to explore qualitative data. A matrix output with cases as row and codes as columns) was developed to summarize data and facilitate comparisons between respondents and topics. [27]

3.6 Health care seeking behavior and social interaction

3.6.1 Objectives

This component aimed to characterize social interactions at the time of data collection and how it changed since the beginning of the pandemic; improve understanding of health-seeking behavior and assess knowledge and perceptions about COVID-19 and related preventative measures. More specifically, the study investigates the following research questions:

1. How can social interactions be characterized in terms of:
    a. Key features – among whom, where do they occur and at which frequency?
    b. Conditions – length of interactions and the use of social distancing?
    c. Drivers – why do people meet face- to-face and are there alternatives to these meetings?
2. What are the most common health-seeking behaviors in the assessed communities?
    a. What is the extent of knowledge and attitudes around use of these behaviors?
    b. Do these behaviors include COVID-19 preventative measures?
    c. What is the extent of knowledge and attitudes around vaccinations by those in assessed communities?
3. How did social interaction and health- seeking behaviors evolve?
    a. During the month before COVID-19?
    b. In the first months after COVID-19, when physical distancing measures were introduced?
    c. At the time of data collection?

This component followed a mixed-methods approach and entailed both a qualitative (focus group discussion (FGD)) and a quantitative part (household survey).

3.6.2 Data sources

This primary data study component focused on Mweso HZ and attempted to include both internally displaced people (IDP; living both in sites and in host communities) as well as host community. Data collection was delayed considerably due to a series of events, including ongoing conflict and insecurity in the study area, as well as the May 2021 volcanic eruption at Mount Nyiragongo, which resulted in the evacuation of REACH staff and a need to support rapid response efforts following this event. As a result, data collection was conducted in October-November 2021, more than 18 months after the first COVID-19 outbreak was detected.

3.6.2.1 Qualitative data collection

For the qualitative component, 12 semi-structured FGDs with a total of 110 participants (55 women and 55 men) were conducted from 27 October to 2 November 2021. The interview guide is available in Annex 2. Three FGDs were conducted in each of four settlements where ACF health centers were located. FGDs were organized according to several key criteria, and participants were purposively sampled according to these characteristics: age category and sex. Participant profiles were purposely varied and included community and religious leaders, elders, shopkeepers, and general community members. FGDs were conducted in Swahili, the local language, by REACH field teams. Each FGD included one discussion facilitator, who guided the conversation according to the qualitative question route designed for the study, and one note taker, who captured key discussion points.

3.6.2.2 Quantitative data collection

See Figure 3 for an overview of the locations assessed through household surveys, as well as areas that were deemed inaccessible due to security constraints (in red in the map). The interview guide is available in annex 3.

In total, 657 household interviews were conducted from 4-13 November 2021. Household level findings are representative with a 95% confidence level and 5% margin of error, and individual level findings are indicative. Interview responses were recorded digitally through KoBo Collect [28], a mobile data collection application that was developed specifically for humanitarian data collection.

The assessment utilized a two-stage cluster sampling approach:

- Stage 1 – Settlement Selection: Using the GRID3[1] geographical database, 28 settlements were randomly selected from a list of 148 settlements larger than five hectares, with a minimum of 12 surveys per settlement. Of these, 22 settlements were surveyed, as the remaining six were found to be inaccessible by data collection teams once deployed in the field. The 6 settlements that could not be reached were not replaced with other accessible settlements; rather additional interviews were conducted in the nearest accessible settlement. Where this was not possible, additional surveys were conducted in other surveyed settlements, with settlements for additional surveys chosen at random. Two of the settlements included in the sample are within Mweso town since it is much larger in terms of population number – resulting in only 21 named settlements are shown in the final analysis.
- Stage 2 – Household selection: Once enumerator teams arrived at the settlements that were randomly selected in stage one, two methods were implemented for randomly selecting households: The primary approach was to generate random GPS points within the boundaries of each settlement, prior to deploying the data collection teams. Under this scenario, teams would go to the generated points, using the maps.me mobile app to navigate, and walk to the house nearest this point to request an interview. In instances where the primary approach was not feasible due to operational or security constraints, the team would instead implement systematic random sampling at the settlement. Teams were trained on this method, according to sampling guidelines instituted by REACH globally: First, they would consult with the village chief and enquire about the number of households in the village. They would divide this number by the number of interviews to be conducted in the village (outcome of this calculation = *n*). Then, the enumerator would spin a pen on the ground at the point that would be indicated by the village elder as being the village center. The enumerator would begin walking in the direction of where the pen was pointing, all the way to the boundary of the location. On the way to the boundary, the enumerator would count the number of households passed. Once the enumerator reached the boundary of the location, he/she would randomly select a number between 1 and the number of houses counted. This number would be the first house to be selected for an interview. Subsequently he/she would attempt to assess every *n*-th household on the righthand side, with *n* determined by the calculation explained above.

3.6.3 Analysis

3.6.3.1 Qualitative analysis

Qualitative data was analyzed using a saturation grid matrix. This process involves listing out the key discussion points raised during the FGDs, organized by research question, and tallying the number of

[1] GRID3 Settlement Extents is a published GIS database which uses satellite imagery to detect areas where there is likely a human settlement, based on the presence of buildings. Each settlement extent has a corresponding estimated population.

times each point was mentioned by participants. This method facilitates identification of the most common perceptions and opinions expressed by the FGD participants, which in turn supports in extracting the key themes and trends from the qualitative data.

3.6.3.2 Quantitative analysis

Descriptive statistics (frequencies, means, proportions) were calculated; associations with selected outcomes were estimated using logistic regression. Quantitative data was disaggregated by various respondent criteria: overall, sex (female or male), age group (18-29, 30-59, or over 60 years old), displacement status (residents and internally displaced), and residence setting (urban and rural). The "period with COVID-19 restrictions" was defined as the period between March 2020 and August 2020 when the churches re-opened. The software used for both the data cleaning and analysis was R 3.60.0 (2019-004-26), in particular the "hypegrammaR" [29], "koboquest" [30], and "surveyweights" [31] packages.

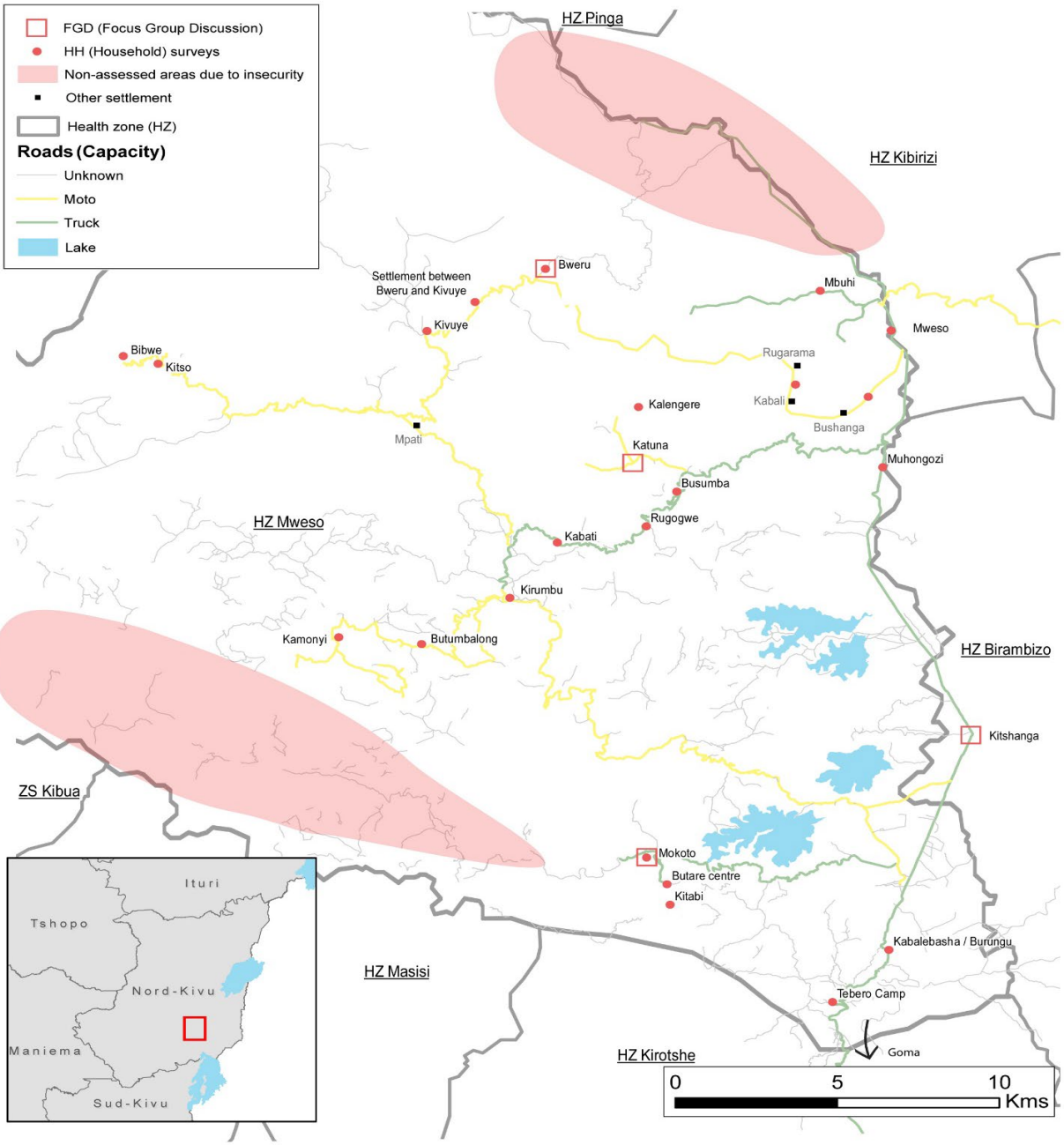

Figure 3: Map of assessed areas for HH and FGD surveys

4 Case study findings

4.1 COVID-19 epidemiology

4.1.1 Key results

- Epidemiology of COVID-19 cases aligned with global epidemiology, with the majority of cases among adults aged 18 to 50 years. Older age and male sex were risk factor associated to higher odds of mortality.
- Incidence rate was highest among people over 60 years of age (81.1/100,000); it was twice as high as in the 18-59 year group.
- Most COVID cases were treated at home. All hospitalizations occurred during the second wave (March 2021).
- The overall case fatality rate (CFR) was 11.1% and was similar between men and women. CFR was 29.2% among the elderly (60+ years) and 13.5% among the cases 0–17-year-olds. CFR were likely overestimated due to the underestimation of cases.
- The largest number of deaths due to COVID-19 occurred in the first half of August 2020 and again between February and March 2021. This corresponds to the first and second wave of COVID-19 in DRC.
- Testing rate increased dramatically in the last quarter of 2020, and the positivity rate was lowest at the same period compared to other months. The low number of testing and high positivity rate at the beginning of the first wave most likely indicates many positive cases were missed.
- Testing capacity initially available only in Goma (North Kivu province's capital), and slowly in more peripherical areas within the province.

4.1.2 Description of the data

4.1.2.1 The datasets

The dataset included 2,213 confirmed COVID-19 cases from the North-Kivu province. Cases were reported between March 27, 2020 (first case recorded in North Kivu) and March 31, 2021 (end of the study period).

4.1.2.2 Completeness by variable

Within the 2,213 observations recorded, the percentage of completeness varied greatly across variables, ranging from 6.4% (site of treatment) to 100% (demographic variables). Table 4 summarizes the completeness of observations in the dataset. The variables concerning demographic features (age, sex, health area, health region, status) as well as date of testing and disease outcomes were the most complete. Profession and site of treatment were mainly missing (available for 6% of the cases). Information about travel were captured in the Comments section: we therefore created a categorical variable (Yes/No) for each case when information was available.

Table 4: Completeness of observations in the dataset of COVID-19 cases in North Kivu

Variable	Percentage
N of cases included in each data set	2,213
Unique Code	98.7%
Health area	83.3%
Health region	99.5%
Status (dead or survived)	99.9%
Sex	99.9%
Age	97.7%
Date of onset symptom	91.9%
Date of sample collection	99.8%
Date of investigation	99.6%
Date of PCR	99.6%
Outcomes	99.9%
Contact case	99.9%
Source of infection	99.9%
Identity of source of case	99.9%
Individual protection equipment	100%
Nationality	64.4%
Occupation	6.5%
Date of discharge	50.0%
Day of testing	99.9%
Comments	66.8%
Site of treatment	6.4%
Epidemiological week	99.9%
Week of discharge	99.9%

4.1.3 Demographic characteristics

Table 5 shows demographic characteristics of confirmed reported cases in North Kivu. The mean age was 41.1 years (± 18.4), ranging from 0 to 125 years with a median age of 39 years. Less than 2% of the cases were reported among children under the age of 5 years. Most of the cases were reported among adults (18 to 50 years) both among men and women. There were more COVID-19 cases in the over 65 years group than the age group 50 to 59. Two thirds of the cases were among males.

Table 5: Distribution of confirmed COVID-19 cases in North-Kivu by age and sex from March 27, 2020 to March 31, 2021

Age	Sex		
	Female	Male	Total
0 – 4	21 (1.0%)	15 (0.7%)	36 (1.7%)
5 – 11	20 (0.9%)	33 (1.5%)	53 (2.4%)
12 – 17	39 (1.8%)	35 (1.6%)	74 (3.4%)
18 - 29	184 (8.5%)	259 (12.0%)	443 (20.5%)
30 – 39	152 (7.0%)	330 (15.3%)	482 (22.3%)
40 – 50	120 (5.6%)	312 (14.4%)	423 (20.0%)
50 – 59	88 (4.1%)	188 (8.7%)	276 (12.8%)
60+	138 (6.4%)	226 (10.5%)	364 (16.8)
Total	762 (35.3%)	1,398 (64.7%)	2,160 (100%)
p-value			<0.001

Figure 4 shows the age pyramid of confirmed COVID-19 cases in North-Kivu province since the first case detected in DRC. The majority of the cases are among adults.

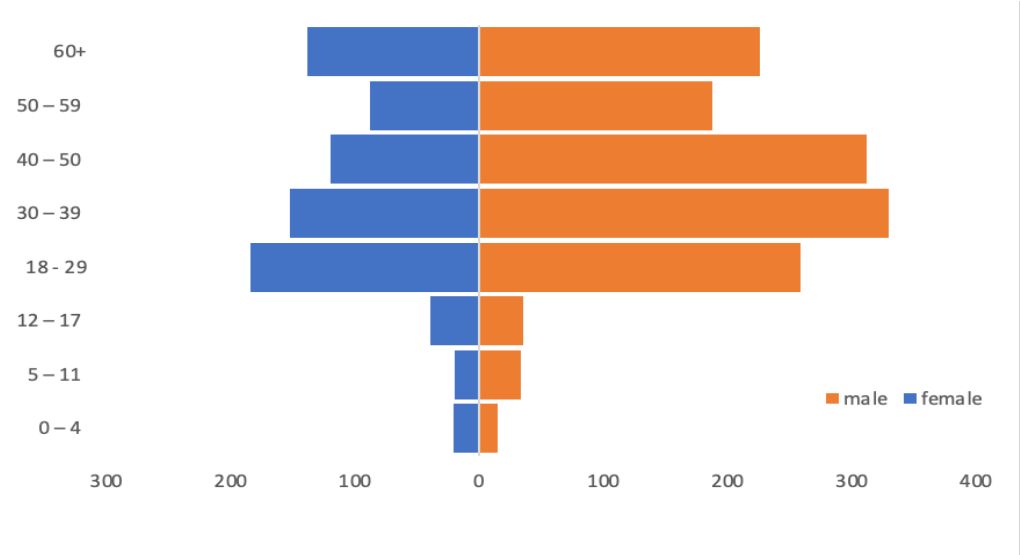

Figure 4: Age pyramid of confirmed cases of COVID-19 in North-Kivu March 27, 2020 to March 31, 2021

Table 6 shows the distribution of confirmed COVID-19 cases in North-Kivu by age, sex, nationality and health district. Almost all cases were from DRC (97.89%), were young adult between 18- and 49-year-old, and male. Other countries comprised Cameroun, Egypt, Niger, Uganda and Kenya in Africa, and Belgium, France, Haiti, Sweden, India, Italia, Canada from another continents. Almost half of the cases originated from Goma, followed by Karisimbi. Only 4.8% of COVID -19 cases have been detected in travel context.

Table 6: Distribution of COVID-19 cases in North-Kivu by age, sex, nationality and health district from March 27, 2020 to March 31, 2021

	Overall	Age									Sex		
		0 – 4	5 – 11	12 – 17	18 – 29	30 – 39	40 – 49	50 – 59	60+	Total	Female	Male	Total
Nationality										p=0.187			p=0.032
Congo	1395 (97.9%)	13 (0.9%)	23 (1.7%)	41 (2.9%)	289 (20.7%)	314 (22.5%)	264 (18.9%)	175 (12.6%)	245 (17.6%)	1364 (97.9%)	495 (34.8%)	897 (63.1%)	1392 (97.9%)
Others	30 (2.1%)	0 (0%)	0 (0%)	0 (0%)	5 (0.4%)	8 (0.6%)	11 (0.8%)	5 (0.4%)	1 (0.1%)	30 (2.2%)	5 (0.4%)	25 (1.8%)	30 (2.1)
Total	1425 (100%)	13 (0.9%)	23 1.7%)	41 (2.9%)	294 (21.1%)	322 (23.1%)	275 (19.7%)	180 (12.9%)	246 (17.7%)	1394 (100%)	500 (35.2%)	922 (64.8%)	1422 (100%)
Health district													
Goma	957 (43.6%)	10 (0.5%)	10 (0.5%)	27 (1.3%)	176 (8.2%)	236 (11%)	200 (9.3%)	130 (6.0%)	133 (6.2%)	922 (42.9%)	303 (13.8%)	654 (29.7%)	957 (43.5%)
Karisimbi	495 (22.5%)	8 (0.4%)	13 (0.6%)	14 (0.7%)	135 (6.3%)	109 (5.1%)	89 (4.1%)	48 (2.2%)	73 (3.4%)	489 (22.7%)	160 (7.3%)	334 (15.2%)	494 (22.5%)
Butembo	160 (7.3%)	3 (0.1%)	2 (0.1%)	10 (0.5%)	27 (1.3%)	20 (0.9%)	38 (1.8%)	19 (0.9%)	39 (1.8%)	158 (7.4%)	69 (3.1%)	91 (4.1%)	160 (7.3%)
Katwa	152 (6.9%)	2 (0.1%)	5 (0.2%)	6 (0.3%)	21 (1%)	20 (0.9%)	30 (1.4%)	26 (1.2%)	41 (1.9%)	151 (7.0%)	72 (3.3%)	78 (3.6%)	150 (6.8%)
Beni	90 (4.1%)	0 (0%)	2 (0.1%)	0 (0%)	9 (0.4%)	27 (1.3%)	18 (0.8%)	13 (0.6%)	19 (0.9%)	88 (4.1%)	25 (1.1%)	65 (3%)	90 (4.1%)
Binza	47 (2.1%)	2 (0.1%)	4 (0.2%)	4 (0.2%)	11 (0.5%)	12 (0.6%)	4 (0.2%)	7 (0.3%)	3 (0.1%)	47 (2.2%)	11 (0.5%)	36 (1.6%)	47 (2.1%)
Kalungunta	36 (1.6%)	0 (0%)	3 (0.1%)	2 (0.1%)	11 (0.5%)	6 (0.3%)	8 (0.4%)	2 (0.1%)	4 (0.2%)	36 (1.7%)	19 (0.9%)	17 (0.8%)	36 (1.6%)
Kyondo	19 (0.9%)	0 (0%)	1 (0.1%)	1 (0.1%)	3 (0.1%)	2 (0.1%)	0 (0%)	2 (0.1%)	10 (0.5%)	19 (0.9%)	8 (0.4%)	11 (0.5%)	19 (0.8%)
Musienene	51 (2.3%)	2 (0.1%)	2 (0.1%)	2 (0.1%)	9 (0.4%)	8 (0.4%)	8 (0.4%)	7 (0.3%)	13 (0.6%)	51 (2.4%)	27 (1.2%)	24 (1.0%)	51 (2.3%)
Nyiragongo	70 (3.2%)	3 (0.1%)	5 (0.2%)	1 (0.1%)	19 (0.9%)	14 (0.7%)	13 (0.6%)	3 (0.1%)	11 (0.51%)	69 (3.2%)	35 (1.6%)	35 (1.6%)	70 (3.2%)
Rutshuru	40 (1.8%)	3 (0.1%)	4 (0.2%)	2 (0.1%)	4 (0.2%)	7 (0.3%)	10 (0.5%)	8 (0.4%)	2 (0.1%)	40 (1.8%)	22 (1.0%)	18 (0.8%)	40 (1.8%)
Oicha	13 (0.6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	5 (0.2%)	1 (0.1%)	1 (0.0%)	5 (0.2%)	12 (0.6%)	5 (0.2%)	8 (0.4%)	13 (0.6%)
Walikale	12 (0.5%)	0 (0%)	0 (0%)	0 (0%)	2 (0.1%)	3 (0.1%)	4 (0.2%)	2 (0.1%)	1 (0.0%)	12 (0.6%)	2 (0.1%)	10 (0.4%)	12 (0.5%)
Other *	60 (2.7%)	3 (0.2%)	1 (0.1%)	5 (0.2%)	12 (0.6%)	13 (0.6%)	9 (0.4%)	7 (0.3%)	7 (0.3%)	57 (2.7%)	17 (0.8%)	43 (2%)	60 (2.7%)
Total	2202 (100%)	36 (1.7%)	52 (2.4%)	74 (3.4%)	439 (20.4%)	482 (22.4%)	432 (20.1%)	275 (12.8%)	361 (16.8%)	2151 (100%)	775 (35.2%)	1424 (64.8%)	2199 (100%)
Other exposure													
Travel	105 (4.7%)	0 (0%)	1 (1.0%)	22 (21.4%)	0 (0%)	25 (24.3%)	15 (14.6%)	15 (14.6%)	15 (14.6%)	103 (100%)	24 (22.9%)	81 (77.1%)	105 (100%)

* Note: Other health districts include Kayna, Kibirizi, Kiroshe, Lubero, Mweso, Pinga, Rwanguba

Information about profession was available for only 6.5% of the cases (N= 143). The most frequently reported profession among cases for which information was available was healthcare workers. They represented 62.9% of cases for which information is available (42% male and 58% in the age group of 18 to 59). The median age was 40 years (IQR: 23 – 69). Humanitarian workers represented 8.4% of the cases for which information about profession was available. Prisoners were 3.5% of the cases for which information about profession was available. The distribution by occupation, age and sex was statically significant (table 7).

Table 7: Distribution of confirmed COVID-19 cases in North-Kivu by profession from March 27, 2020 to March 31, 2021

	Overall	Age				Sex		
		0 – 17	18 – 59	60+	Total	Female	Male	Total
Healthcare worker	90 (62.9%)	0 (0%)	82 (57.7%)	7 (4.9%)	89 (62.7%)	29 (20.3%)	61 (42.7%)	90 (62.9%)
State employee	5 (3.5%)	0 (0%)	3 (2.1%)	2 (1.4%)	2 (1.4%)	0 (0%)	5 (3.5%)	5 (3.5%)
Shopkeeper	9 (6.3%)	0 (0%)	8 (5.6%)	1 (0.7%)	9 (6.3%)	1 (0.7%)	8 (5.6%)	9 (6.3%)
Humanitarian	12 (8.4%)	0 (0%)	11 (7.7%)	1 (0.7%)	12 (8.4%)	2 (1.4%)	10 (7.0%)	12 (8.4%)
Student	8 (5.6%)	3 (2.1%)	5 (3.5%)	0 (0.0%)	8 (5.6%)	1 (0.7%)	7 (4.9%)	8 (5.6%)
Prisoner	5 (3.5%)	0 (0.0%)	5 (3.5%)	0 (0.0%)	5 (3.5%)	0 (0.0%)	5 (3.5%)	5 (3.5%)
Housewife	6 (4.2%)	0 (0.0%)	4 (2.8%)	2 (1.4%)	6 (4.2%)	5 (3.5%)	1 (0.7%)	6 (4.2%)
Other	8 (5.6%)	0 (0.0%)	5 (3.5%)	3 (2.1%)	8 (5.6%)	1 (0.7%)	7 (4.9%)	8 (5.6%)
Total	143 (100%)	3 (2.1%)	123 (86.6%)	16 (11.3%)	142 (100%)	39 (27.3%)	104 (72.7%)	143 (100%)
p-value				0.001			0.023	

4.1.4 Epi curve based on date of sample collection

The number of confirmed cases increased progressively with a peak in August 2020 (first wave) and a second wave in March 2021 (figure 5). Epi curve in North Kivu seems to follow with a few weeks delay the pattern at national level.

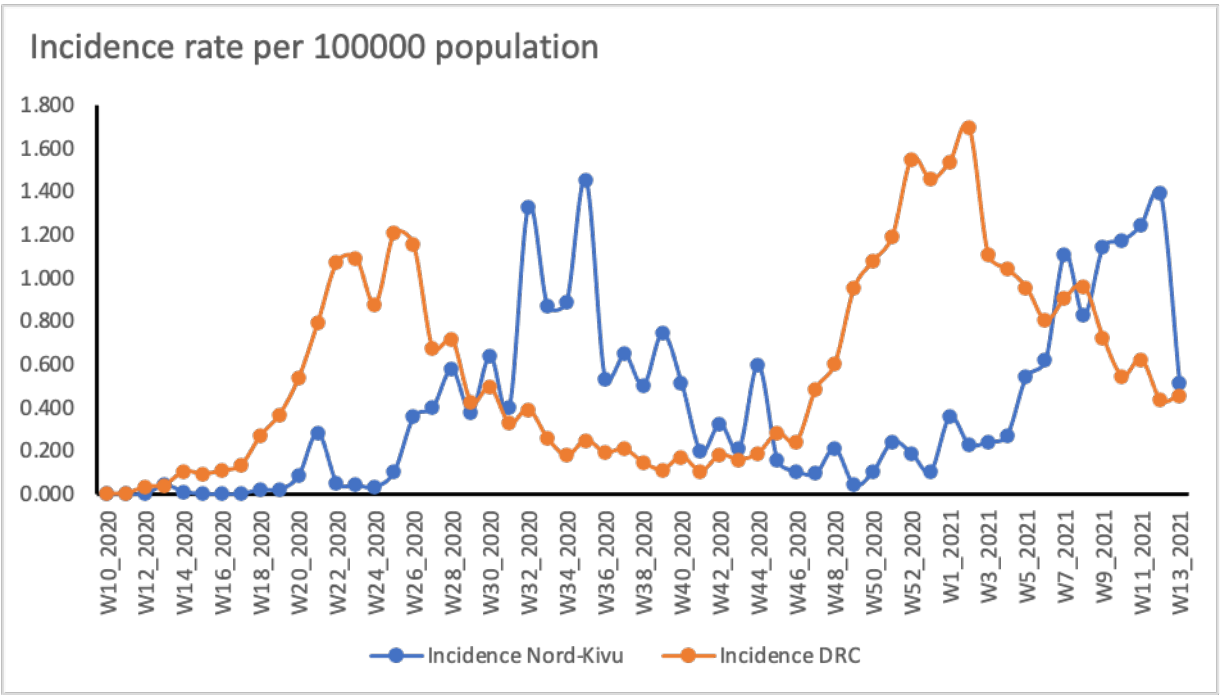

Figure 5: Epidemiological curve of confirmed COVID-19 cases per week per 100000 population in North-Kivu and DRC since the first case detected in DRC from March 10, 2020 to March 31, 2021

4.1.5 Incidence rates

Table 8 shows incidence rates among the entire population and disaggregated by age groups. Incidence rate in the entire population was 23.15/ 100,000 people in North Kivu. The incidence rate was lower among children (4.65/100,000) and increased to 42.68/100,000 among adult population. The incidence rate is highest among people over 60 years of age (81.1/100,000); it is twice as high as in the lower age group.

Table 8: Incidence rate per age group of one-year confirmed cases of COVID-19 in North-Kivu from March 27, 2020 to March 31, 2021

	Total population	0 – 17	18 – 59	60+
Cases	2,213	163 (7.5%)	1,635 (75.6%)	364 (16.8%)
Population	9,559,904.9	4,540,954.83 (47.5%)	3718,803.01 (38.9%)	449,315.53 (4.7%)
IR (100,000)	23.15	4.65	42.68	81.01
CI (95%)	24.11 – 22.18	5.27 – 4.02	44.77 – 40.58	89.33 – 72.69

Note: source of population estimates: DHIS2, Ministry of Health, DRC

4.1.6 Testing capacity

Table 9 shows the testing parameters of COVID-19 in North-Kivu from June 2020 to March 2021 (no data are available for the months of March, April and May 2020). The number of tests increased mostly in the last quarter in 2020 to reach about 14,900 in December 2020. The positivity rate was its lowest levels at the same time. Figure 6 shows the incidence rate, testing rate and positivity rate for COVID-19 during the study period. From the symptom onset to sample collection for testing, on average, there was a delay of 0.27 day ± 3.45 ranging from 0 to 92 days. The delay varied from 0.046 day ±0.41 [0, 5] in age group < 18 years; 0.33 day ± 3.96 [0, 92] in age group 18 – 59; to 0.14 day ± 1.39 [0, 17] in the elderly.

Table 9: Overall test capacity for COVID-19 in North-Kivu from June 1, 2020 to March 31, 2021

	Number of cases	Number of monthly tests	Incidence rate (100,000 people	Testing rate (100,000 people)	Positivity rate (%)
Jun 20 - Mar 21	1,791	70,017	18.73	73.2	2.6%
By month					
June 2020	142	1,387	1.49	14.5	10.2
July 2020	298	1,754	3.12	18.3	17.0
August 2020	310	2,916	3.24	30.5	10.6
September 2020	148	7,843	1.55	82.0	1.9
October 2020	231	11,707	2.42	122.5	2.0
November 2020	57	10,518	0.60	110.0	0.5
December 2020	43	14,906	0.45	155.9	0.3
January 2021	66	6,011	0.69	62.9	1.1
February 2021	200	6,667	2.09	69.7	3.0
March 2021	296	6,308	3.10	66.0	4.7

Notes: Total population (North Kivu): 9,559,904.9 (DHIS2, Ministry of Health, DRC)

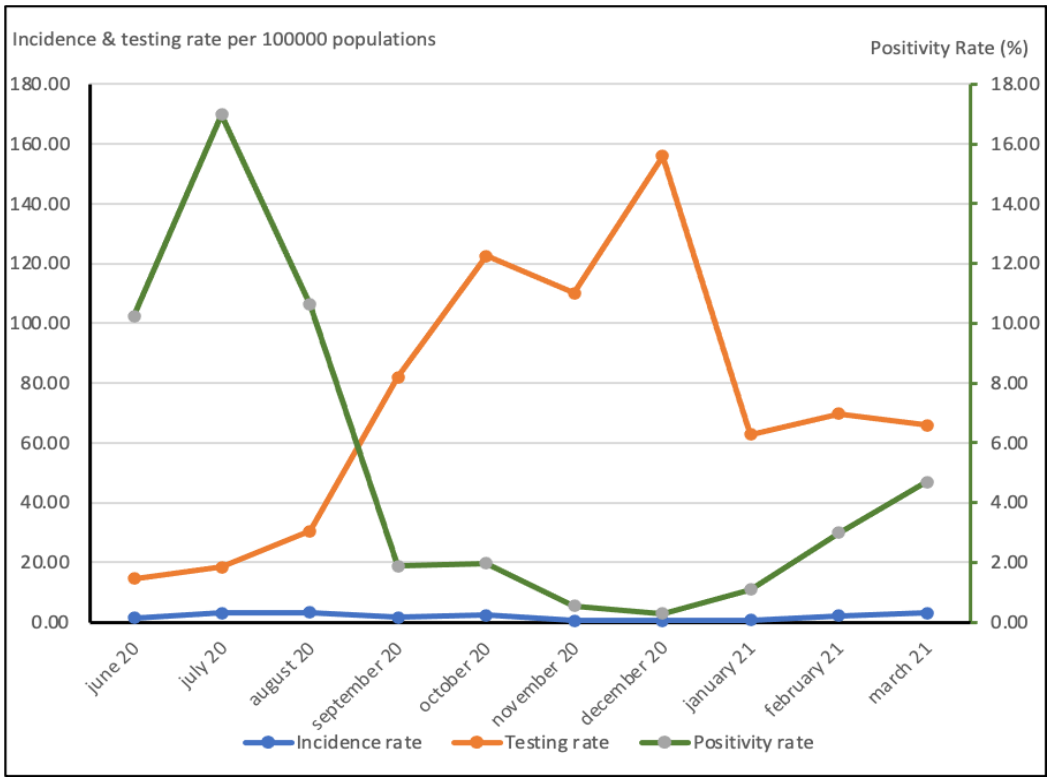

Figure 6: Incidence rate, testing rate and positivity rate for COVID-19 in North-Kivu from June 1, 2020 to March 31, 2021

4.1.7 Case management

Table 10 shows the distribution of confirmed COVID-19 cases by case management characteristics, age and sex. Data about case management is patchy and available for 2,211 cases who were classified as hospitalized, repatriated, recovered or dead. We report case management status in table 10 and hospitalization rates in table 11. Hospitalization was reported for 78 cases (3.5%); treatment site is available for 141 cases, who were mainly treated at home (72.3%). A small number of foreign cases were repatriated (0.5%).

Table 10: Distribution of confirmed cases of COVID-19 in North-Kivu by clinical features, age and sex from March 27, 2020 to March 31, 2021

	Overall	Age				Sex		
		0 – 17	18 – 59	60+	Total	Female	Male	Total
Case Management (N=2,211)								
Hospitalized	78 (3.5%)	4 (0.2%)	60 (2.8%)	13 (0.6%)	77 (3.6%)	29 (1.3%)	47 (2.1%)	76 (3.4%)
Repatriated	11 (0.5%)	0 (0%)	10 (0.5%)	1 (0.1%)	11 (0.5%)	2 (0.1%)	9 (0.4%)	11 (0.5%)
Treatment site								
Home	102 (72.3%)	8 (5.8%)	81 (59.2%)	12 (8.8%)	101 (73.7%)	31 (22%)	71 (50.4%)	102 (72.4%)
Treatment center	39 (27.7%)	0 (0%)	32 (23.4%)	4 (2.9%)	36 (26.3%)	12 (8.51%)	27 (19.2%)	39 (27.7%)
Total	141 (100%)	8 (5.8%)	113 (82.5%)	16 (11.7%)	137 (100%)	43 (30.5%)	98 (69.5%)	141 (100%)
p-value			0.245				0.965	

Seventy-eight (78) cases required hospitalization (3.5%). Information about age and sex was available for 77 and 76 cases respectively. All hospitalizations recorded in the dataset occurred during weeks 12 and 13 of 2021 which corresponded to the second wave (March 2021; table 11). It is unclear whether no other cases were hospitalized in the early weeks of the pandemic or if this information was not recorded.

Table 11: Hospitalization of confirmed COVID-19 cases over time from March 27, 2020 to March 31, 2021

	Sex		
Week	Female	Male	Total
W12_2021	12 (15.8%)	16 (21.1%)	28 (36.8%)
W13_2021	17 (22.4%)	31 (40.8%)	48 (63.5%)
Total	29 (38.5%)	47 (61.8%)	76 (100%)

4.1.8 Disease outcomes

Table 12 shows the distribution of cases by disease outcome (death or recovery) and selected case characteristics. The majority of patients recovered from COVID-19 (88.9%). The overall CFR was 11.1%. CFR among the elderly cases was three times this value (29.2%; p<0.001), while it was 13.5% among the cases 0–17-year-old. CFR was similar between men and women.

Table 12: Distribution of COVID-19 cases in North Kivu by disease outcome and selected case characteristics (age, sex, health zone and treatment site) between March 27, 2020 and March 31, 2021

	Death N (%)	Recovery N (%)	Total N (%)*	P-value
Overall	244 (11.1%)	1956 (88.9%)	2200 (100%)	
Age				0.000
0 – 17	22 (13.5%)	141 (86.5%)	163 (100%)	
18 – 59	95 (5.9%)	1528 (94.1%)	1623 (100%)	
60+	106 (29.2%)	257 (70.8%)	363 (100%)	
Total	223 (10.4%)	1926 (89.6%)	2149 (100%)	
Sex				0.245
Female	78 (10.1%)	698 (89.9%)	776 (100%)	
Male	166 (11.7%)	1255 (88.3%)	1421 (100%)	
Total	244 (11.1%)	1953 (88.9%)	2197 (100%)	
Nationality				0.488
Congo	156 (11.2%)	1237 (88.8%)	1393 (100%)	
Other	2 (8.3%)	22 (91.7%)	24 (100%)	
Total	158 (11.2%)	1259 (88.8%)	1417 (100%)	
Health zone				0.120
Other	12 (22.2%)	42 (77.8%)	54 (100%)	
Goma	98 (10.3%)	854 (89.7%)	952 (100%)	
Karisimbi	41 (8.3%)	453 (91.7%)	494 (100%)	
Butembo	23 (14.4%)	137 (85.6%)	160 (100%)	
Katwa	21 (13.8%)	131 (86.2%)	152 (100%)	
Beni	5 (5.6%)	85 (94.4%)	90 (100%)	
Binza	8 (17.0%)	39 (83.0%)	47 (100%)	
Kalungunta	4 (11.1%)	32 (88.9%)	36 (100%)	
Kyondo	3 (15.8%)	16 (84.2%)	19 (100%)	
Musienene	11 (21.6%)	40 (78.4%)	51 (100%)	
Nyiragongo	12 (17.1%)	58 (82.9%)	70 (100%)	
Rutshuru	3 (7.7%)	36 (92.3%)	39 (100%)	
Oicha	2 (15.4%)	11 (84.6%)	13 (100%)	
Walikale	0 (0%)	12 (100%)	12 (100%)	
Total	243 (11.1%)	1946 (88.9%)	2189 (100%)	
Treatment site				0.416
Home	11 (10.9%)	90 (89.1%)	101 (100%)	
Ctcov	3 (7.7%)	36 (92.3%)	39 (100%)	
Total	14 (10.0%)	126 (90%)	140 (100%)	

* Proportions are row-wise

Figure 7 shows the distribution of deaths over time per epidemiological week. The largest number of deaths due to COVID-19 occurred in the first half of August 2020 and again between February and March 2021.

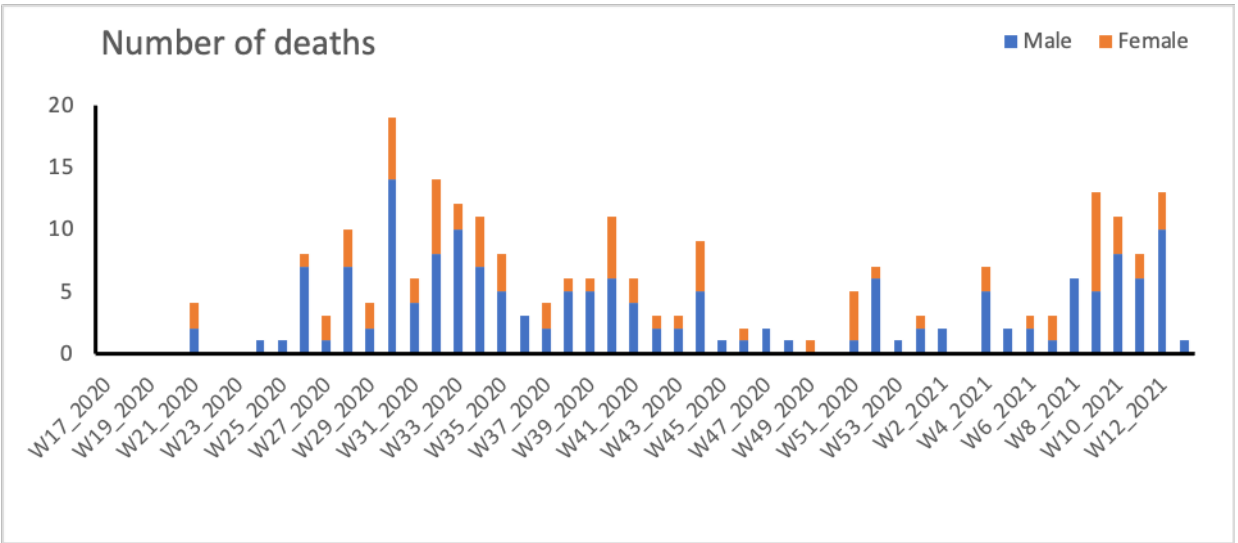

Figure 7: Number of deaths from COVID-19 in North-Kivu, DRC between March 27, 2020 and March 31, 2021

Overall, CFRs ranged between 1.7% in May 2020 to 19.3% in March 2021. The CFR curve grows progressively from 1.6% in May 2020 to 4.2% in June, and abruptly reaches 18% on two successive months in July and August 2020 (Figure 8). Except for October 2020, CFR remained below 6% between September 2020 and February 2021. It showed a spike again in March 2021 (19%).

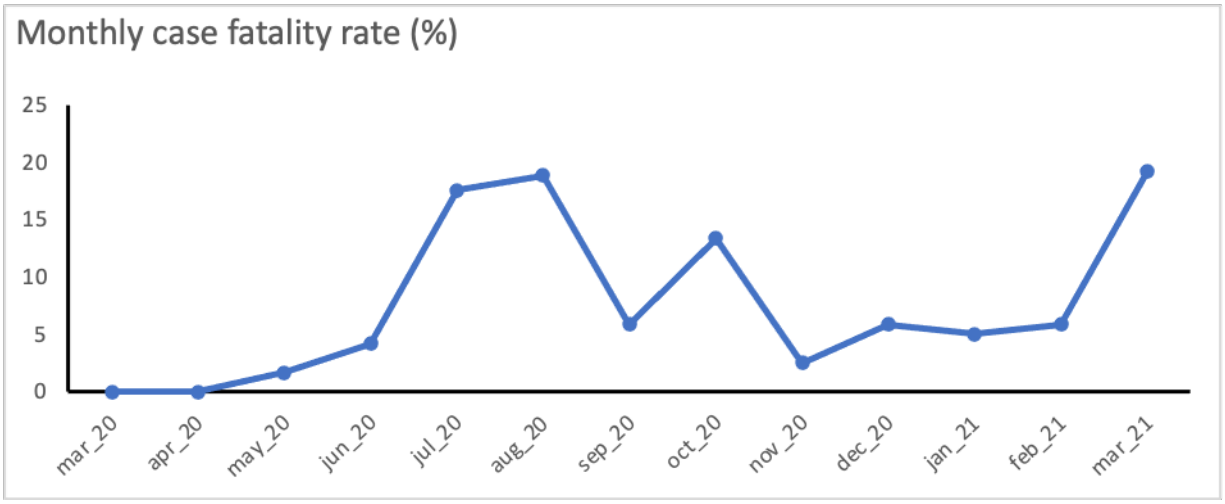

Figure 8: Monthly case fatality rate in North-Kivu from March 27, 2020 to March 31, 2021

4.1.9 Risk factors associated with disease outcomes

Table 13 shows the adjusted odds ratios for disease outcome (mortality) estimated by multivariate logistic regression. Risk factors include age and sex. Advanced age (older than 60 years) was associated with higher odds for death (results were statistically significant) when compared to the adult reference

population. Younger age (0-17 years) also increased the odds of mortality. Male cases had higher odds of dying compared to female cases.

Table 13: Factors associated with mortality among COVID-19 cases in North Kivu from March 27, 2020 to March 31, 2021

	Odds ratios	Standard error	p-value	95% CI
Age				
0 – 17	2.62	0.67	0.000	1.59 – 4.32
60+	6.81	1.08	0.000	5.0 – 9.29
Ref: 18 – 59				
Sex				
Male	1.42	0.22	0.029	1.04 – 1.95
Ref: female				
Health district				
Goma	0.44	0.21	0.091	0.17 – 1.14
Ref: Other				

4.2 Routine health services

Results on how health services were affected are presented by outcome indicators. For each indicator, results are presented in three components:

1. One table with numeric results: Incidence Rate Ratio (IRR) for immediate change, IRR for change in slope, absolute cumulative difference between expected and observed consultations, monthly average % difference.
2. One graph per subregion depicting trend over time (observed values, fitted model and counterfactual) over the study period.
3. One graph per subregion showing the percent difference from expected value during the study period.

Supplementary material in annex 4 include trend by health area, residual assessment and sensitivity analysis.

4.2.1 Key results

The result overview is presented in figure 9, which shows point estimates (dot) and the confidence intervals (bar) for the outcome measures (IRR for immediate change at the beginning of the pandemic and IRR in change in slope) for each indicator and by subregion.

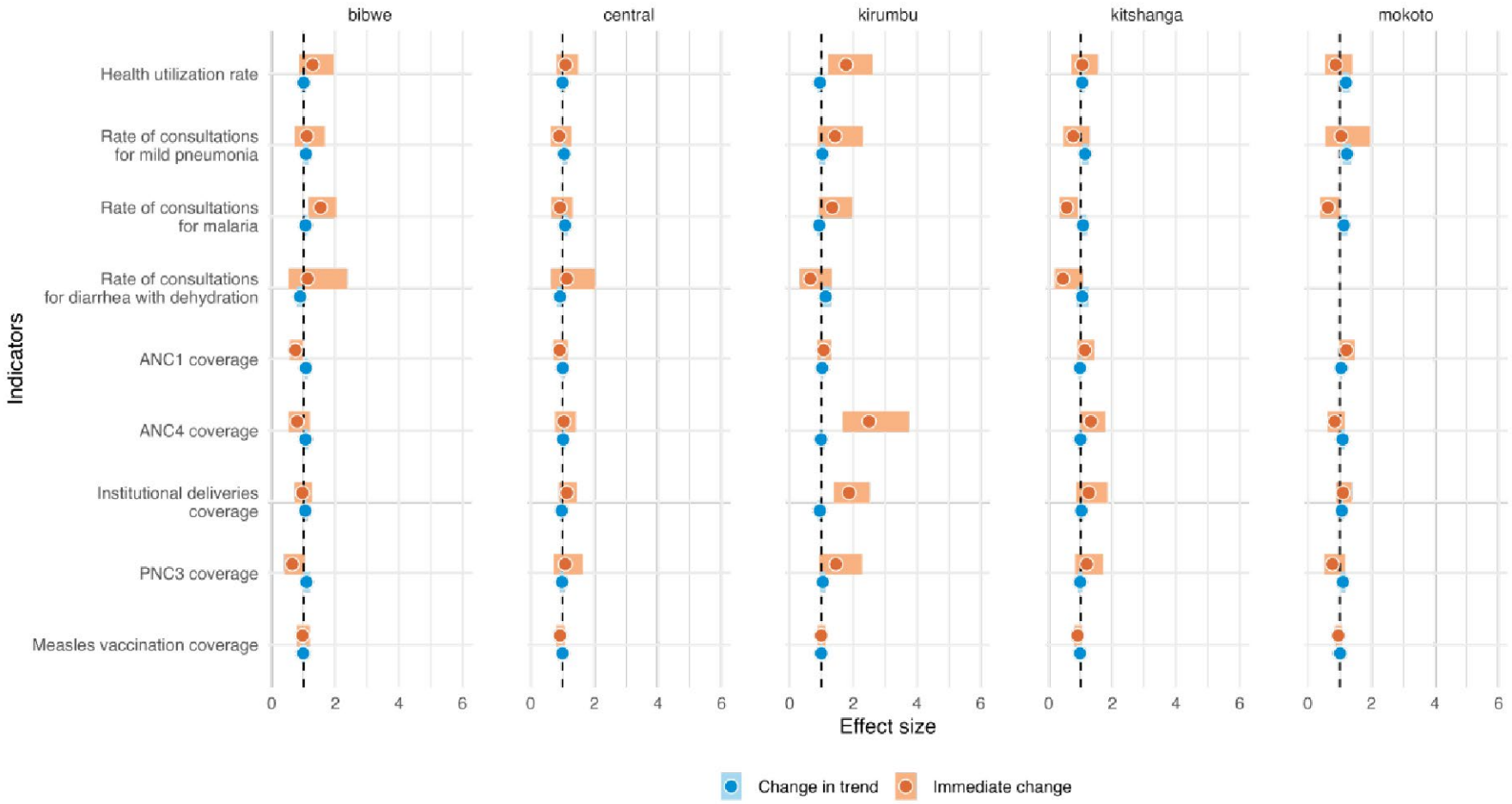

Figure 9: Forest plot of the interrupted time series results, by subregion and indicator, Mweso health zone, DRC

Key results include:

- **OPD consultations**: immediate increase in all subregions, although results are statistically significant in only two. COVID-19 trend does not seem to differ from pre-COVID-19 trend (except for one subregion which reported an increase over time). High variations before COVID-19 led to a quite unstable model fit.
- **Malaria consultations**: mixed results, with three subregions reporting an increase in consultations mainly due to an increasing trend during the COVID-19 period, rather than an increase at the beginning of the COVID-19 period. Two other subregions reported a decrease in consultations for suspected malaria.
- **Consultations for diarrhea with dehydration**: mixed results, both within and across subregions and none is statistically significant. High monthly variability both during the pre-COVID-19 and the COVID-19 periods.
- **Consultations for mild pneumonia**: mixed results have been reported at the beginning of the pandemic, with three subregions reporting an increase and two a decrease. However, all subregions reported an increase in the change in slope.
- **Measles cases**: in 50% of the health areas, the average number of cases per week increased during the COVID-19 period. The majority of the health areas reported many more suspect measles cases during the COVID-19 period than before.
- **Cholera cases**: majority of health areas report lower average weekly numbers of cholera cases in the COVID-19 period. Highest number of cases occurred in 2018.
- **Maternal health services (antenatal, deliveries, postnatal care):** except for mixed results for ANC1, all other maternal health services reported an increase in all subregions.
- **Measles vaccination**: all subregions reported a decrease in the number of vaccine doses delivered.

4.2.2 Health utilization rate

Table 14 presents the results for the four outcome measures of the interrupted time series analysis. Four of the five subregions reported an increase in consultations at the beginning of the pandemic, ranging from a 5% increase in Kitshanga to a 77% increase in Kirumbu (IRR: 1.775, [95%CI: 1.205-2.614]), result which is statistically significant. Slopes are mainly around 1 in four of the five subregions, showing little to no difference from the trends before COVID-19; in Mokoto, the trend over time during the COVID-19 period reported a 19% increase (IRR: 1.198, [95%CI: 1.096 – 1.308]). Figure 10 shows mean health utilization rates before and during the COVID-19 period, as well as the counterfactual during the COVID-19 period. With regard to the absolute changes in OPD consultations over the entire COVID-19 period, all areas reported an increase ranging from 4,723 more consultations in Kitshanga to 23,692 in Kirumbu compared to what was expected. Monthly change ranges from 11% in Central subregion to 58% in Mokoto. Figure 11 shows the percent difference between expected and observed values over the entire study period. Discrepancies from expected values can be observed even in the pre-COVID-19 period, reflecting the challenges of fitting a model when consultation trends are unstable.

Because of these deviations in model fit in pre-COVID-19 period, as well as results of model diagnostics (Supplement), results should be interpreted with caution. From Q-Q plots, we see that data are not normally distributed, especially for Central. While for Bibwe residuals are largely normally distributed, distribution of residuals for Kitshanga and Mokoto is skewed. This could be explained by some unexpected peaks and falls in health utilization rate in some of the health areas (for example, in October 2019 in Kamonyi health area in Kirumbu; in January 2018 in Yopa health area in Kitshanga).

Table 14: Interrupted Time Series results for health utilization rate: immediate change (A), change in slope (B), cumulative difference (C) and percent monthly change (D), by subregion, Mweso health zone, 2017-2021

	A		B		C	D
Subregion	Immediate change		Change in slope		Cumulative difference	Percent monthly change
	Estimate	P-value	Estimate	p-value		
Bibwe	1.291 [0.856 to 1.949]	0.224	1.008 [0.931 to 1.091]	0.849	6,919 [3,280 to 10,430]	20 [11 to 30]
Central	1.097 [0.806 to 1.495]	0.556	0.999 [0.943 to 1.059]	0.980	23,692 [13,674 to 34,720]	11 [6 to 17]
Kitshanga	1.053 [0.716 to 1.547]	0.794	1.05 [0.977 to 1.129]	0.183	4,723 [3,016 to 6,371]	18 [11 to 26]
Kirumbu	1.775 [1.205 to 2.614]	0.004	0.952 [0.883 to 1.026]	0.196	10,706 [8,830 to 12,793]	35 [27 to 45]
Mokoto	0.87 [0.542 to 1.396]	0.563	1.198 [1.096 to 1.308]	0.000	5,860 [5,076 to 6,731]	58 [45 to 76]

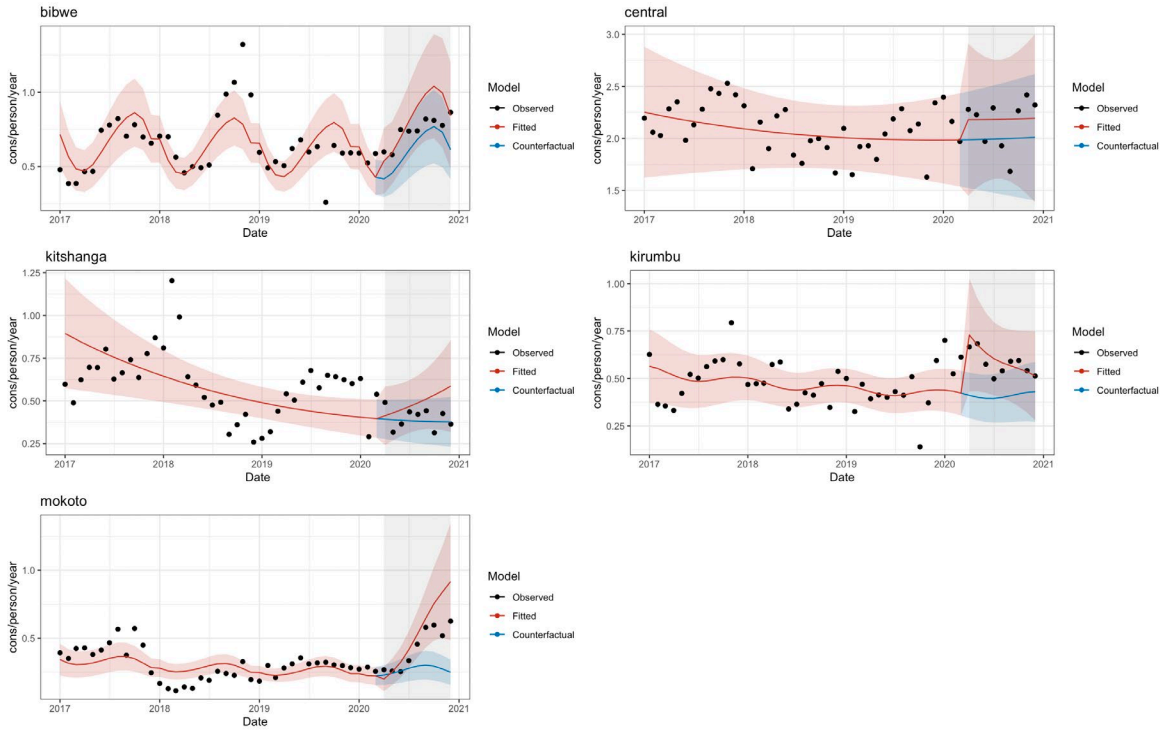

Figure 10: Mean Health Utilization rate: results of ITS analysis showing observed values, fitted model and counterfactual, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC

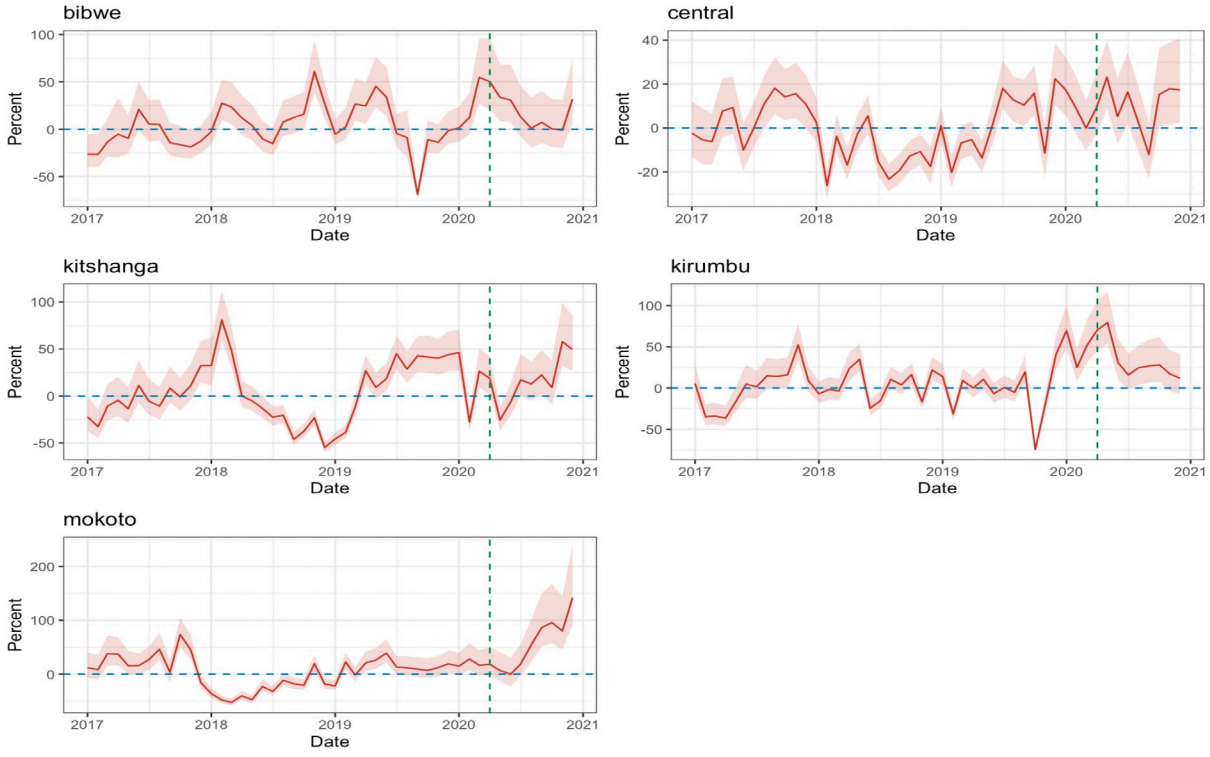

Figure 11: Percent difference between expected and observed values – Health Utilization Rate, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

4.2.3 Consultations for suspected malaria

Mixed results in consultations for malaria can be seen (table 15). An increase in consultations over the COVID-19 period was observed in three of the five subregions (Bibwe, Central and Mokoto) which reported respectively 6,115, 36,159 and 1,070 more consultations for suspected malaria over the COVID-19 period compared to what was expected. These increases appear to be mainly due to an increase in slope over time (by 6%, 8% and 13% respectively: IRR: 1.064 [95%CI: 1.007 to 1.124]; IRR: 1.083 [95%CI: 1.013 to 1.157]; 1.131 [95%CI: 1.037 to 1.233]) instead of an immediate increase at the beginning of the pandemic. The immediate change was seen and statistically significant only in Bibwe (IRR: 1.541 [95%CI: 1.166 to 2.037] corresponding to a 54% increase at the beginning of the pandemic). A decrease in consultations for suspected malaria was observed in Kitshanga and Kirumbu: a decrease by 44% at the beginning of the pandemic (IRR: 0.564 [95%CI: 0.343 to 0.926]) is reported in Kitshanga while a negative change in slope was reported in Kirumbu (IRR: 0.926 [95% CI: 0.859 to 0.997].

Figure 12 shows mean consultation rates for suspected malaria before and during the COVID-19 period, as well as the counterfactual during the COVID-19 period. Figure 13 shows the percent difference between expected and observed values over the entire study period. As for health utilization rate, there are some periods for which, even in the pre-COVID-19 period, the model does not fit well (e.g., January 2018 for Kitshanga, June 2017 and October 2019 for Kirumbu, February 2020 for Mokoto). These correspond to evolution of trends in malaria consultations that deviates from the longer trends and seasonal pattern in those health areas and subregions, respectively. As seen in Supplement, in January 2018, there was an unusual rise in consultations in Yopa (Kitshanga subregion), more than doubling from the previous month. In Kirumbu subregion, there was a sharp rise in malaria consultations in June 2017 in Busumba health area, and a sharp fall in consultations in October 2019 in Kamonyi health area. In Mokoto, consultations quadrupled in February 2020 in Kibarizo health area. This does lead to problems with model fit (model diagnostics provided in Supplement). Kirumbu has relatively good fit; data is close to normally distributed, and residuals are close to normal, although fitted values underestimate some of the higher response values. For Central, residuals are close to normally distributed, while for Mokoto, residuals are close to normally distributed with a few exceptions. Residuals for Kitshanga are slightly skewed.

Table 15: Interrupted Time Series results for consultations for suspected malaria: immediate change (A), change in slope (B), cumulative difference (C) and percent monthly change (D), by subregion, Mweso health zone, 2017-2021

	A		B		C	D
Subregion	Immediate change		Change in slope		Cumulative difference	Percent monthly change
	Estimate	P-value	Estimate	p-value		
Bibwe	1.541 [1.166 to 2.037]	0.002	1.064 [1.007 to 1.124]	0.027	6,115 [5,888 to 6,349]	95 [88 to 102]
Central	0.925 [0.65 to 1.317]	0.665	1.083 [1.013 to 1.157]	0.019	36,159 [28,621 to 43,885]	28 [20 to 36]
Kitshanga	0.564 [0.343 to 0.926]	0.024	1.082 [0.985 to 1.188]	0.100	-5,210 [-6,610 to -3,701]	-27 [-33 to -19]
Kirumbu	1.339 [0.91 to 1.97]	0.139	0.926 [0.859 to 0.997]	0.041	-912 [-3,034 to 1,210]	-2 [-9 to -7]
Mokoto	0.631 [0.395 to 1.009]	0.054	1.131 [1.037 to 1.233]	0.005	1,070 [359 to 1,764]	11 [2 to 21]

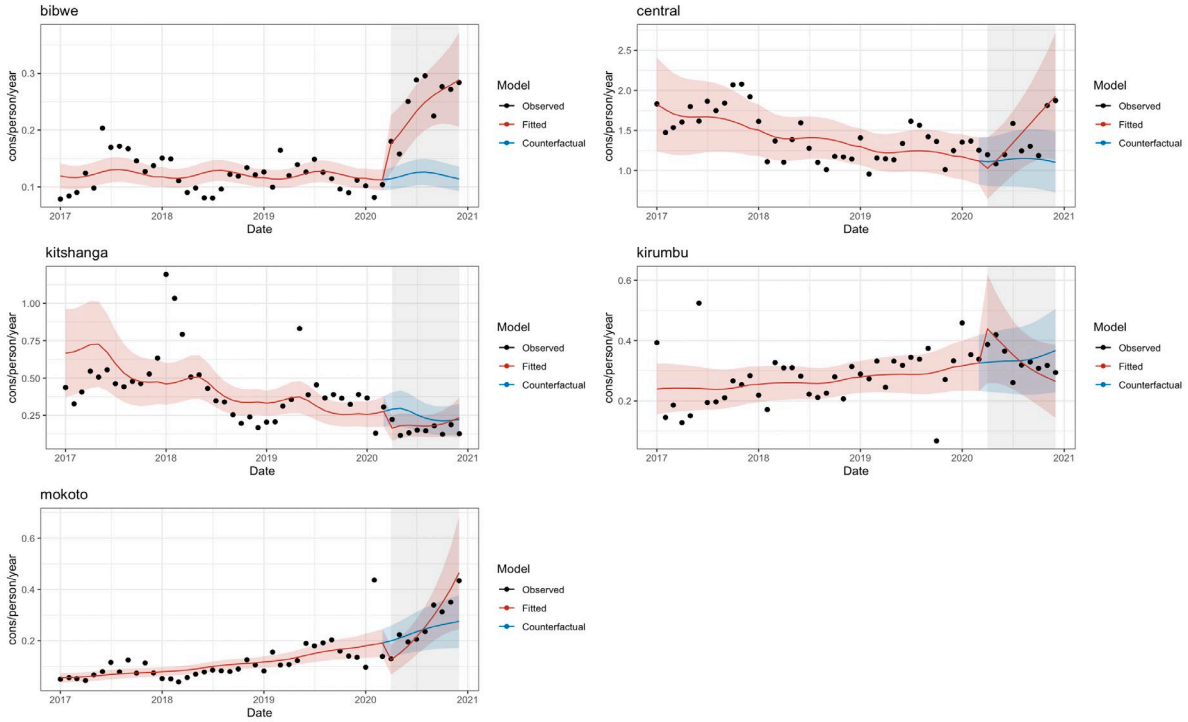

Figure 12: Mean suspected malaria consultation rate: results of ITS analysis showing observed values, fitted model and counterfactual, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC

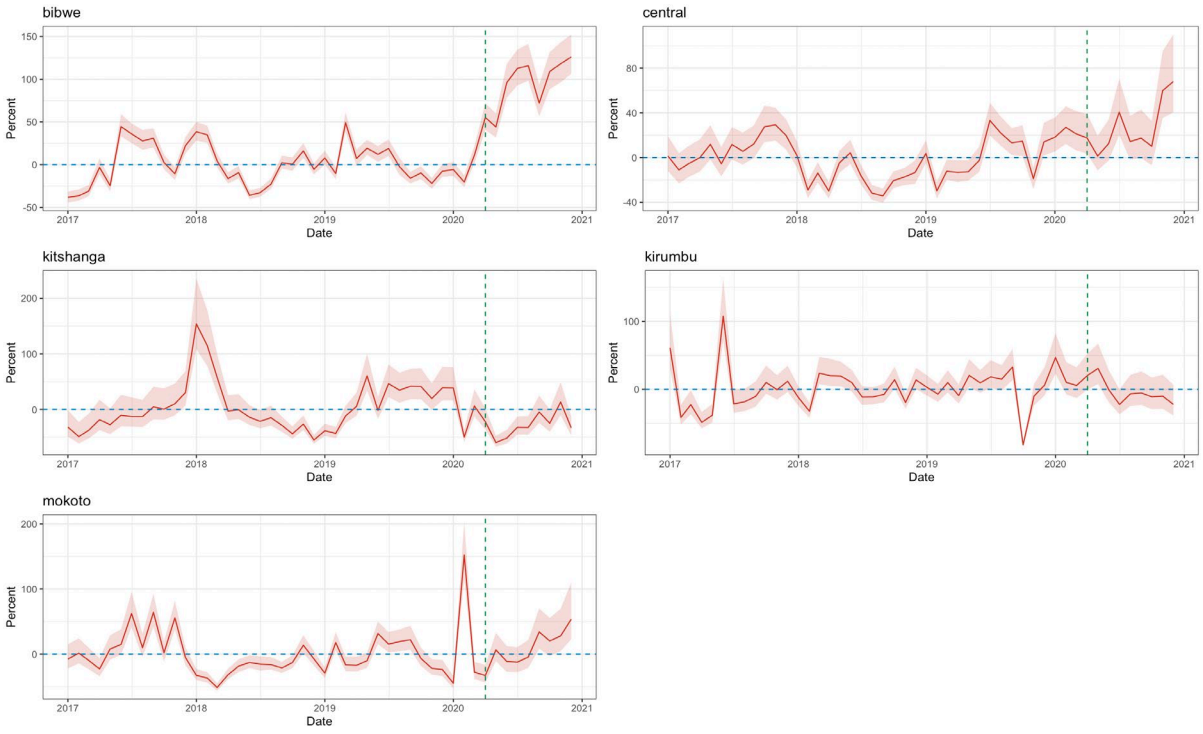

Figure 13: Percent difference between observed and expected values – consultations for suspected malaria, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

4.2.4 Diarrhea with dehydration

Table 16 shows the ITS results for consultations for diarrhea with dehydration. Results are mixed, both within and across subregions and none is statistically significant. Both Bibwe and Central subregions report an increase in consultations at the beginning of the pandemic, but a negative slope. The opposite can be seen for Kirumbu and Kitshanga (decrease at the beginning of the pandemic and increase over time). Cumulative differences are negative for three of the four subregions included in the analysis and range between -1,665 consultations in Central to +118 in Kirumbu.

Figure 14 and results from model diagnostics (supplement) show challenges faced in fitting a model when consultations are unstable. Model for Kitshanga in particular does not seem to capture well the variation in trends over time. Residuals are not normally distributed for any of the health areas and fitted values do not capture well especially the larger response values. Figure 15 shows high monthly variability both during the pre-COVID-19 and the COVID-19 periods.

Table 16: Interrupted Time Series results for consultations for diarrhea with dehydration: immediate change (A), change in slope (B), cumulative difference (C) and percent monthly change (D), by subregion, Mweso health zone, 2017-2021

	A		B		C	D
Subregion	Immediate change		Change in slope		Cumulative difference	Percent monthly change
	Estimate	P-value	Estimate	p-value		
Bibwe	1.131 [0.537 to 2.38]	0.746	0.899 [0.783 to 1.033]	0.132	-98 [-145 to -48]	-19 [-28 to -6]
Central	1.136 [0.636 to 2.029]	0.667	0.926 [0.823 to 1.042]	0.200	-1,665 [-2342 to -976]	-14 [-20 to -9]
Kirumbu	0.651 [0.319 to 1.328]	0.238	1.131 [0.994 to 1.288]	0.062	118 [24 to 213]	16 [2 to 36]
Kitshanga	0.446 [0.184 to 1.079]	0.073	1.053 [0.884 to 1.255]	0.559	-455 [-521 to -398]	-50 [-54 to -46]

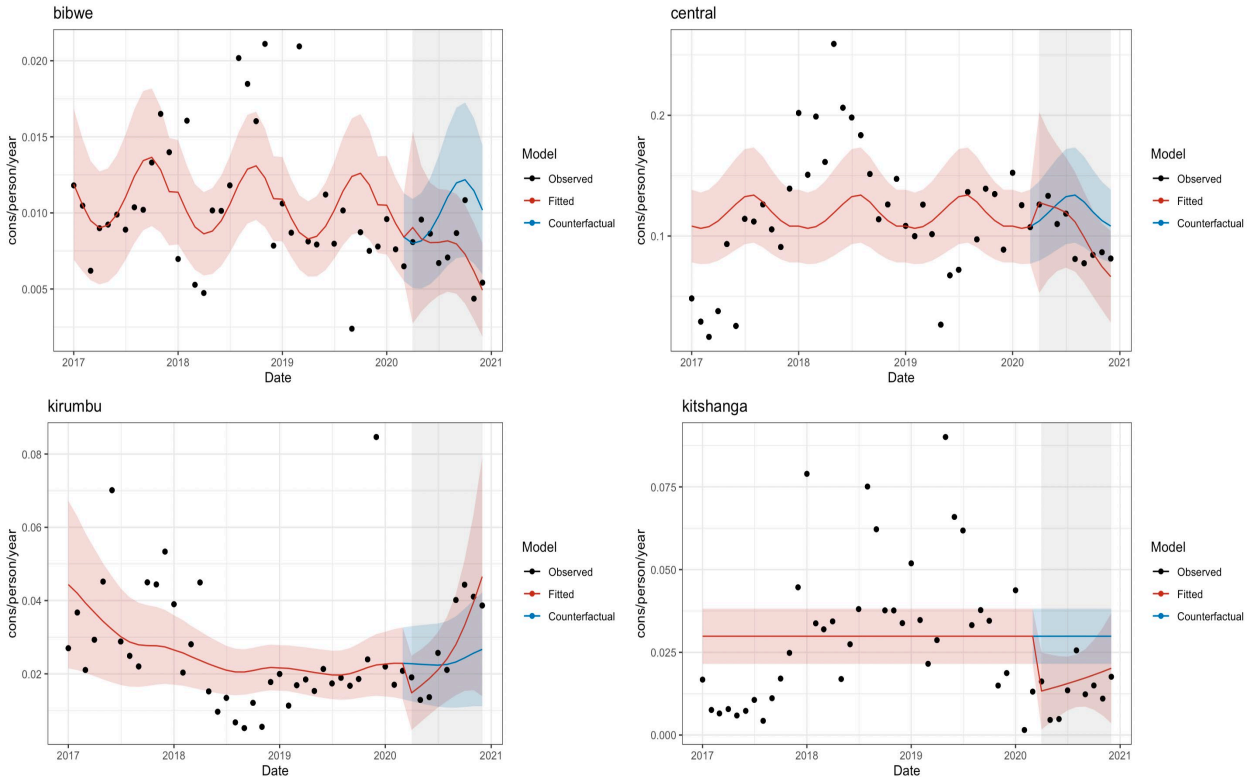

Figure 14: Mean consultation rate for diarrhea with dehydration: results of ITS analysis showing observed values, fitted model and counterfactual, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

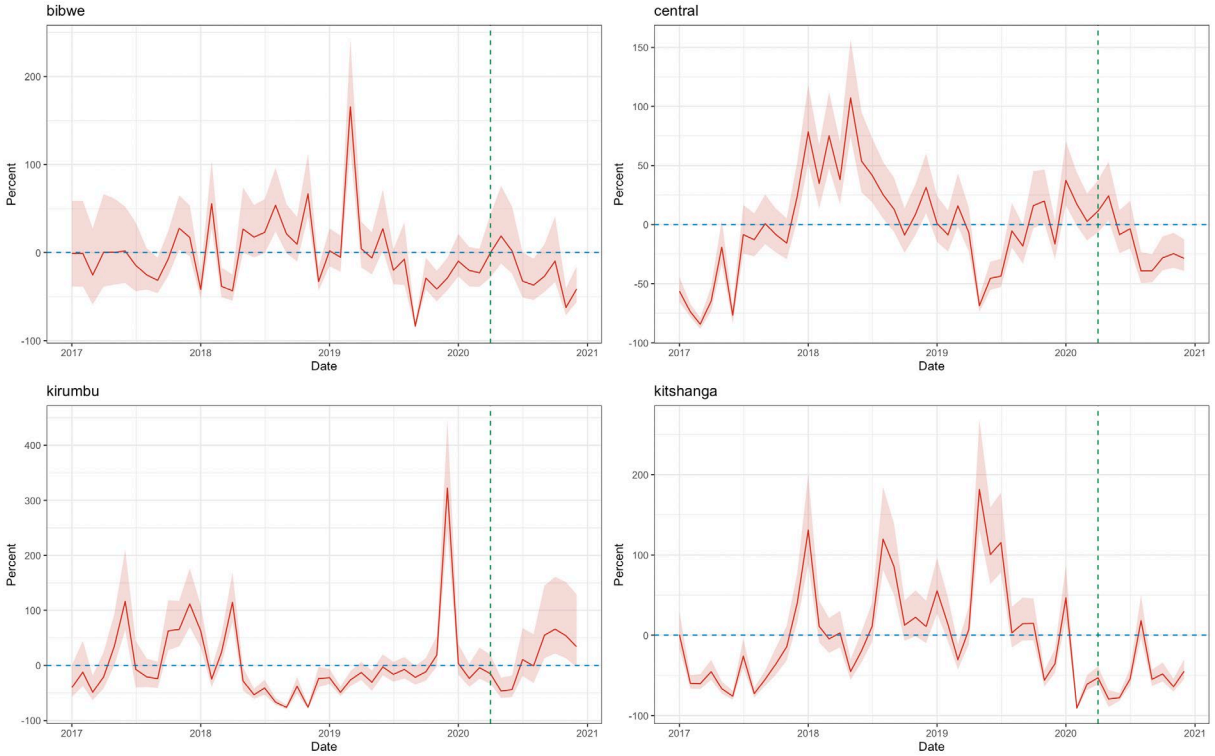

Figure 15: Percent difference between observed and expected values – consultations for diarrhea with dehydration, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC

4.2.5 Mild pneumonia

Table 17 and Figure 16 show the results of the ITS analysis. Mixed results have been reported at the beginning of the pandemic, with three subregions reporting an increase and two a decrease. However, all subregions reported an increase in the change in slope, ranging from +2.5% in Kirumbu to +22% in Mokoto. Results in Bibwe (IRR: 1.082 [95%CI: 1.003 to 1.167]), Kitshanga (IRR: 1.142 [95%CI: 1.037 to 1.257]) and Mokoto (IRR: 1.223 [95%CI: 1.09 to 1.371]) are statistically significant. The cumulative difference is positive in four of the five subregions, ranging from +962 to + 2,610 consultations for mild pneumonia. Only Kitshanga subregion reported a decrease (by 479 consultations).

Model fit is generally acceptable, except in Central, where there is an unusual increase in pneumonia consultations in early 2018, and Kirumbu, which also appears to have an increase in late 2017 – early 2018. The standard deviation of residuals is quite large for all subregions (Supplement), and data are noisy. For Mokoto, the difference in the COVID-19 period well surpasses deviation in the pre-COVID-19 period, which is indicative that the difference is unlikely to be due to noise alone (figure 17).

Table 17: Interrupted Time Series results for rate of consultations for mild pneumonia: immediate change (A), change in slope (B), cumulative difference (C) and percent monthly change (D), by subregion, Mweso health zone, 2017-2021

	A		B		C	D
Subregion	Immediate change		Change in slope		Cumulative difference	Percent monthly change
	Estimate	P-value	Estimate	p-value		
Bibwe	1.11 [0.738 to 1.671]	0.616	1.082 [1.003 to 1.167]	0.042	1,898 [1,359 to 2,421]	31 [21 to 44]
Central	0.896 [0.626 to 1.283]	0.548	1.055 [0.984 to 1.131]	0.134	962 [128 to 1,894]	7 [1 to 14]
Kitshanga	0.773 [0.462 to 1.293]	0.326	1.142 [1.037 to 1.257]	0.007	-479 [-892 to -21]	-8 [-16 to 1]
Kirumbu	1.428 [0.889 to 2.295]	0.141	1.025 [0.935 to 1.123]	0.598	1,720 [1,298 to 2,122]	33 [23 to 44]
Mokoto	1.044 [0.556 to 1.962]	0.893	1.223 [1.09 to 1.371]	0.001	2,610 [2,389 to 2,822]	153 [127 to 185]

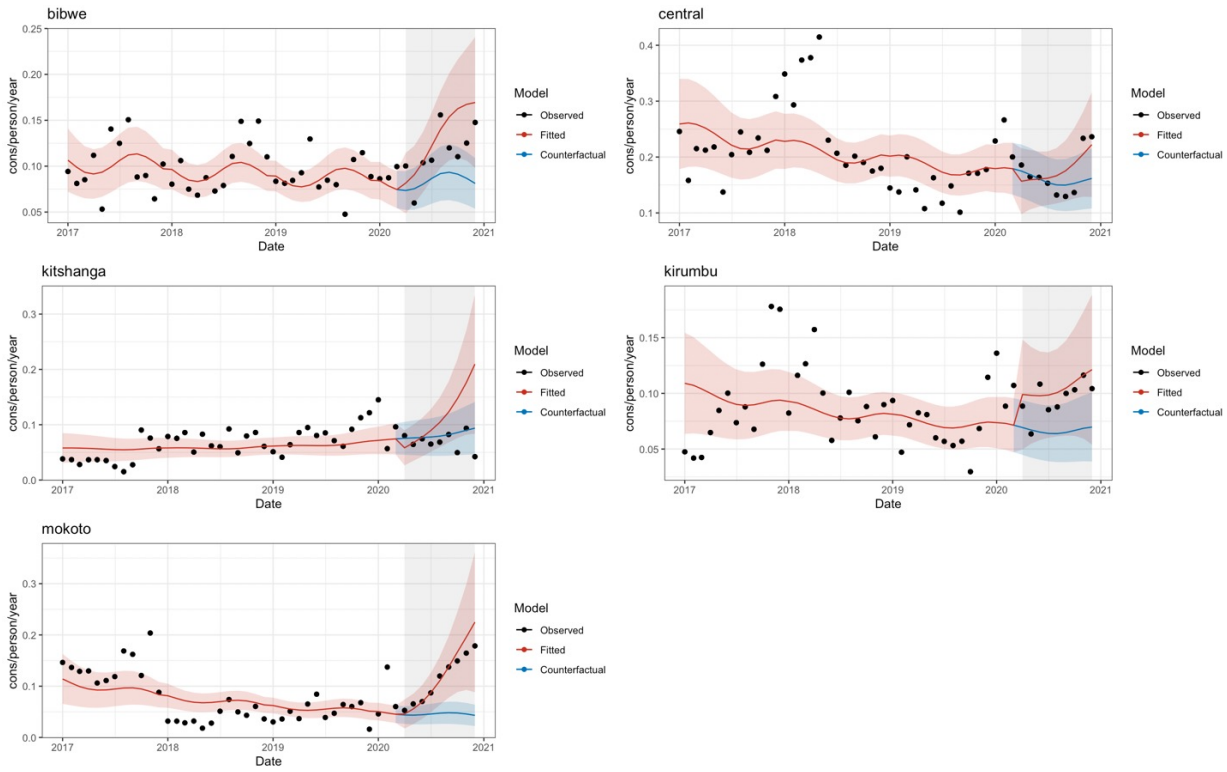

Figure 16: Mean consultation rate for mild pneumonia: results of ITS analysis showing observed values, fitted model and counterfactual, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC

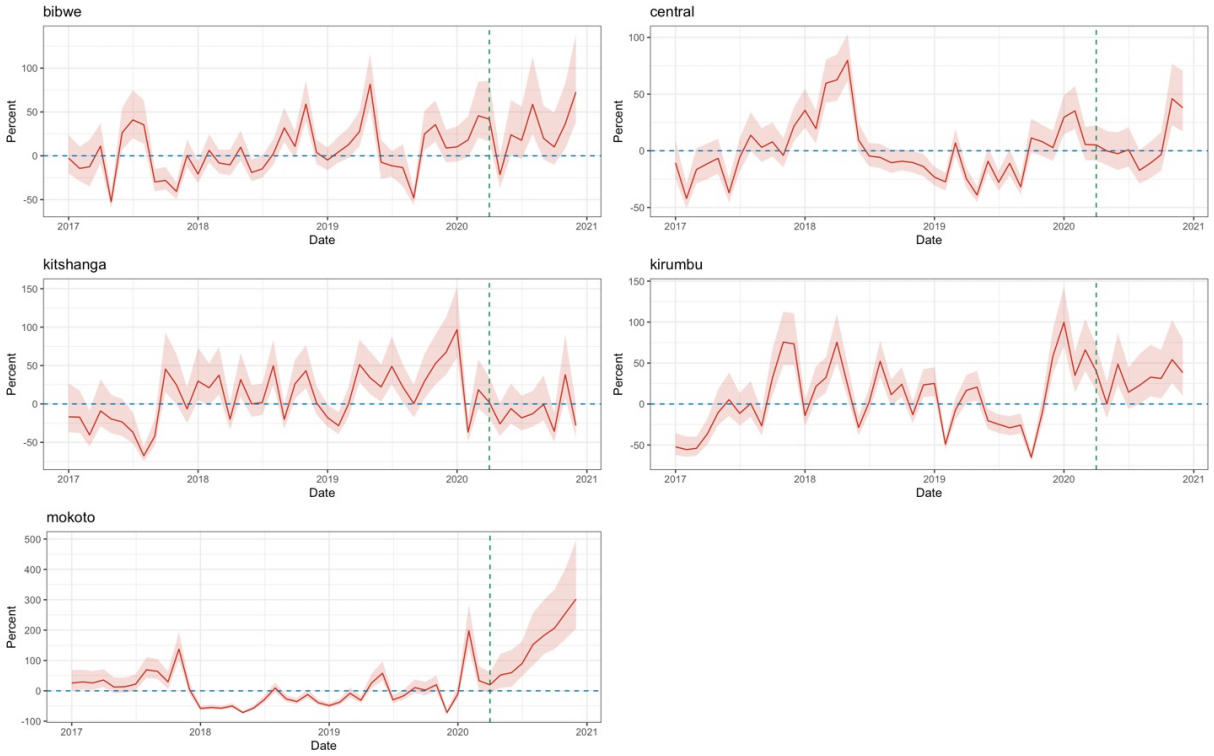

Figure 17: Percent difference between observed and expected values – consultations for mild pneumonia, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

4.2.6 Measles cases

Table 18 shows the average weekly number of suspected measles cases in the pre COVID-19 and in the COVID-19 periods for health areas. The average during the COVID-19 period is higher than the average pre-COVID-19 in 12 out of 21 health areas (cells in grey). Only two health areas reported a higher average in the pre-COVID-19 period (blue cells). While several health areas reported their first measles case early 2020 before the beginning of the COVID-19 period, many more suspected measles cases occurred in the COVID-19 period than the years before as can be seen in figures 18 to 22.

Table 18: Average weekly number of suspected measles cases pre-COVID vs COVID period, by health area and subregion, Mweso health zone, Jan 2017 to March 2021, DRC.

Subregion	Health area	Pre-COVID-19 mean number of cases (weekly)	COVID-19 mean number of cases (weekly)	Date of first week reporting cases
Bibwe	bibwe	0.0645	6.2778	2020-03-30
	bweru	0.0000	0.0000	
	kivuye	0.0000	0.2188	2020-05-25
Central	bukama	0.0066	1.6000	2018-09-10
	bushanga	0.0000	2.1429	2020-04-06
	kalembe	0.3986	2.2286	2020-03-02
	kashuga	0.2532	2.3636	2017-03-13
	rugarama	0.0068	0.0000	2020-02-24
Kirumbu	busumba	0.0000	0.0000	
	kamonyi	0.0000	0.2353	2020-04-20
	katuna	0.0000	0.0000	
	kirumbu	0.0129	0.1176	2020-03-30
Kitshanga	burungu	0.0000	0.5556	2020-04-06
	kichanga	0.0000	0.3429	2020-06-22
	mwanja	0.0000	0.0000	
	st_benoit	0.1250	2.0833	2020-02-10
	yopa	0.0000	0.0000	
Mokoto	kibarizo	0.0000	0.0000	
	mokoto	0.0068	0.0000	2020-01-13
	tambi	0.0000	0.0000	
	hgr mweso	2.9677	5.3714	2017-03-27

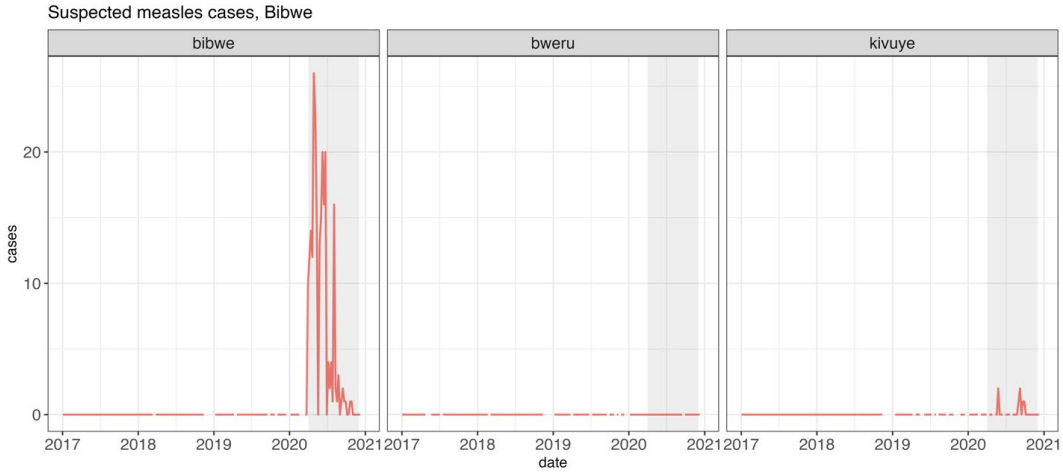

Figure 18: Number of suspected measles cases in Bibwe subregion, Mweso health zone, DRC, by health area, 2017-2021

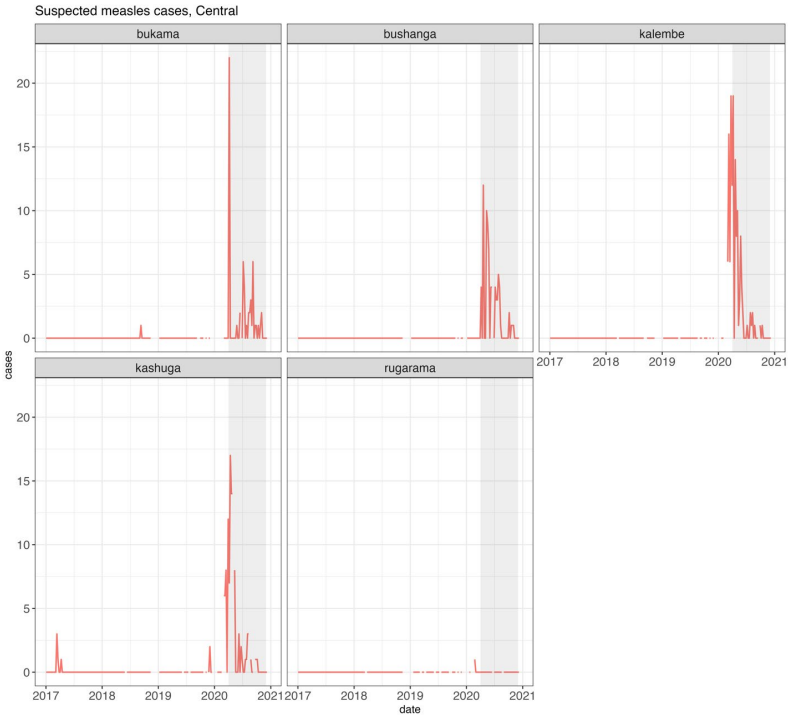

Figure 19: Number of suspected measles cases in Central subregion, Mweso health zone, DRC, 2017-2021 by health area

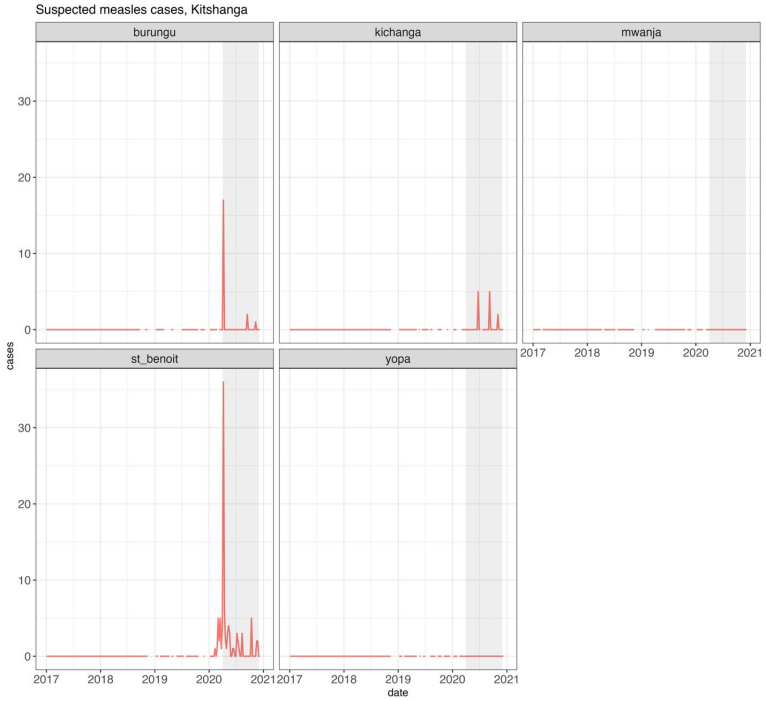

Figure 20: Number of suspect measles cases in Kitshanga subregion, Mweso health zone, DRC, 2017-2021 (by health area)

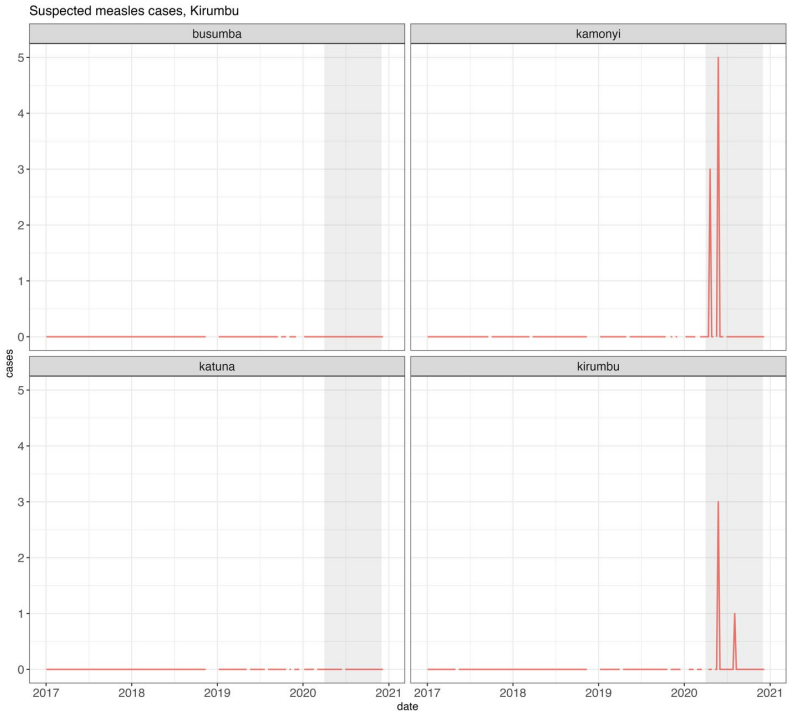

Figure 21: Number of suspect measles cases in Kirumbu subregion, Mweso health zone, DRC, 2017 -2021, by health area

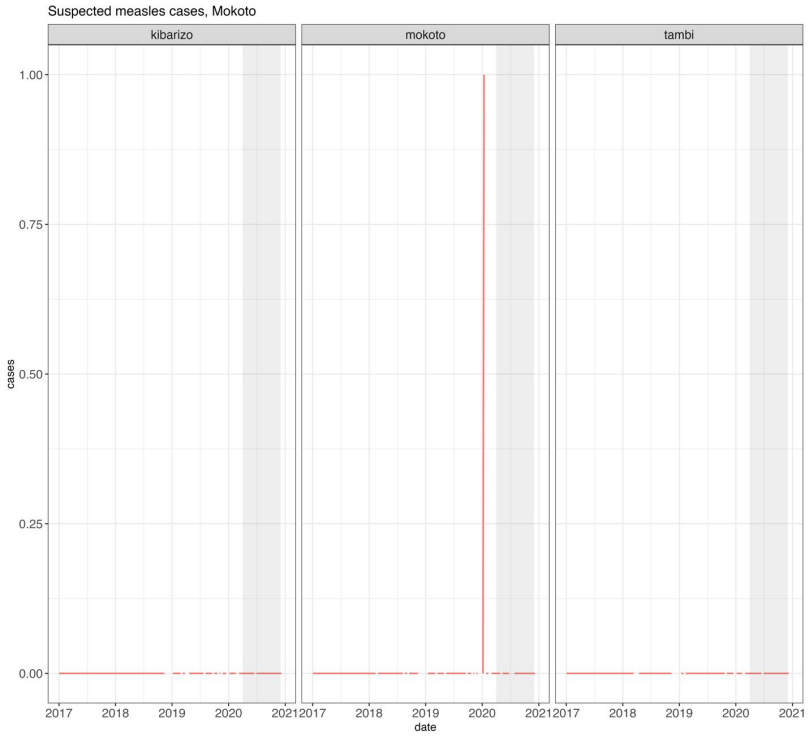

Figure 22: Number of suspect measles cases, Mokoto subregion, Mweso health zone, DRC, 2017-2021, by health area

4.2.7 Cholera cases

Table 19 reports the average weekly number of suspected cholera cases during the pre-COVID-19 and the COVID-19 period. Differently from measles, cholera cases have been reported since 2017 / 2018 in many health areas, and the average weekly number in the pre-COVID-19 period is higher than in the COVID-19 period (blue cells). Only the health area of Bukama in the Central subregion reported a higher weekly average number of cholera cases in the COVID-19 period than in the pre-COVID-19 period. The majority of cases occurred in 2018 (figures 23 to 28).

Table 19: Average weekly number of suspected cholera cases pre-COVID vs COVID period, by health area and subregion, Mweso health zone, Jan 2017 to March 2021, DRC

Subregion	Health area	pre-COVID mean number of cases (weekly)	COVID mean number of cases (weekly)	date of first week reporting cases
Bibwe	Bibwe	0.0710	0.0000	2017-10-16
	Bweru	0.0133	0.0000	2018-02-05
	Kivuye	0.0000	0.0000	
Central	Bukama	0.0000	0.2857	2020-10-05
	Bushanga	0.0000	0.0000	
	Kalembe	0.0068	0.0000	2017-04-17
	Kashuga	0.3896	0.0000	2017-10-02
	Rugarama	0.0000	0.0000	
Kirumbu	Busumba	0.0000	0.0000	
	Kamonyi	0.8026	0.0000	2017-10-23
	Katuna	0.0000	0.0000	
	Kirumbu	0.1290	0.0000	2018-01-08
Kitshanga	Burungu	0.0000	0.0000	
	Kichanga	0.0408	0.0000	2019-05-20
	Mwanja	0.0000	0.0000	
	St Benoit	3.6645	3.3333	2017-12-04
	Yopa	0.0000	0.0000	
Mokoto	Kibarizo	0.2649	0.0000	2019-01-14
	Mokoto	0.0473	0.0000	2018-01-15
	Tambi	0.5948	0.1143	2017-10-16
	hgr mweso	3.1742	0.6000	2017-01-02

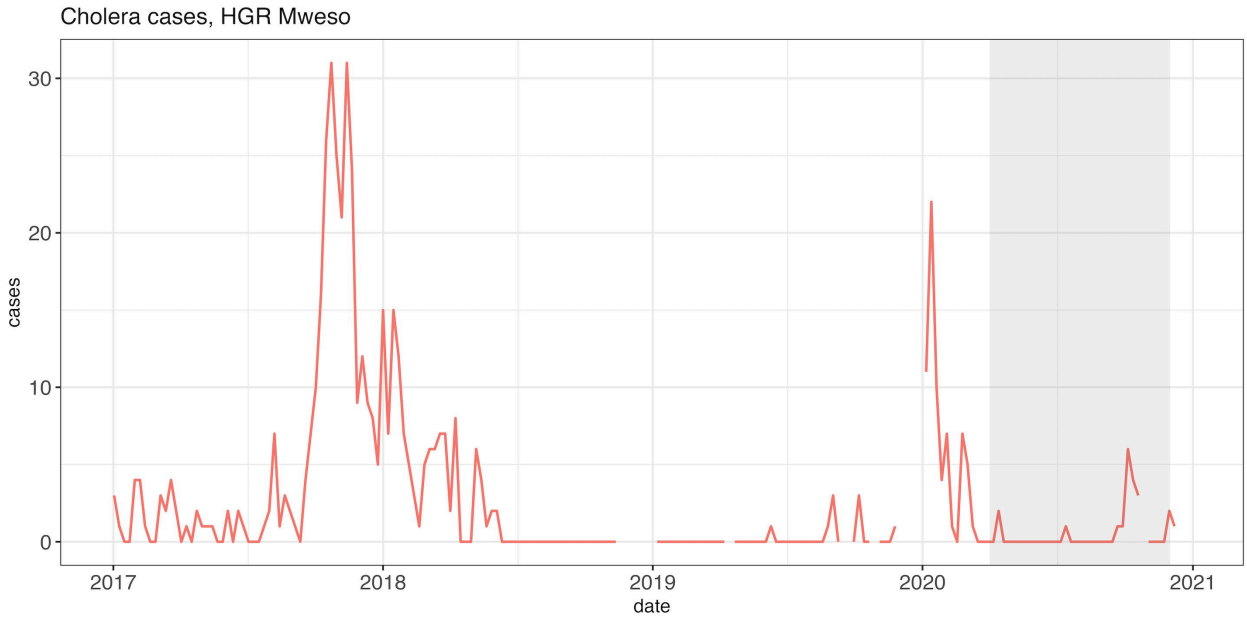

Figure 23: Number of suspected cholera cases in Mweso Referral hospital, Mweso health zone, DRC, by health area, 2017-2021

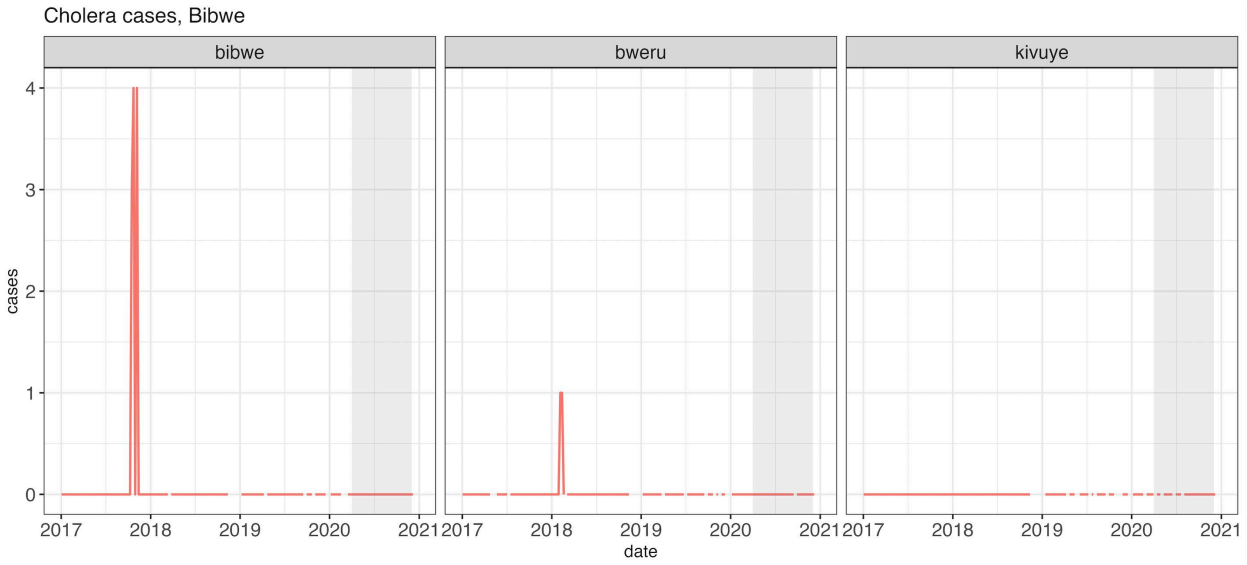

Figure 24: Number of suspected cholera cases in Bibwe subregion, Mweso health zone, DRC, by health area, 2017-2021

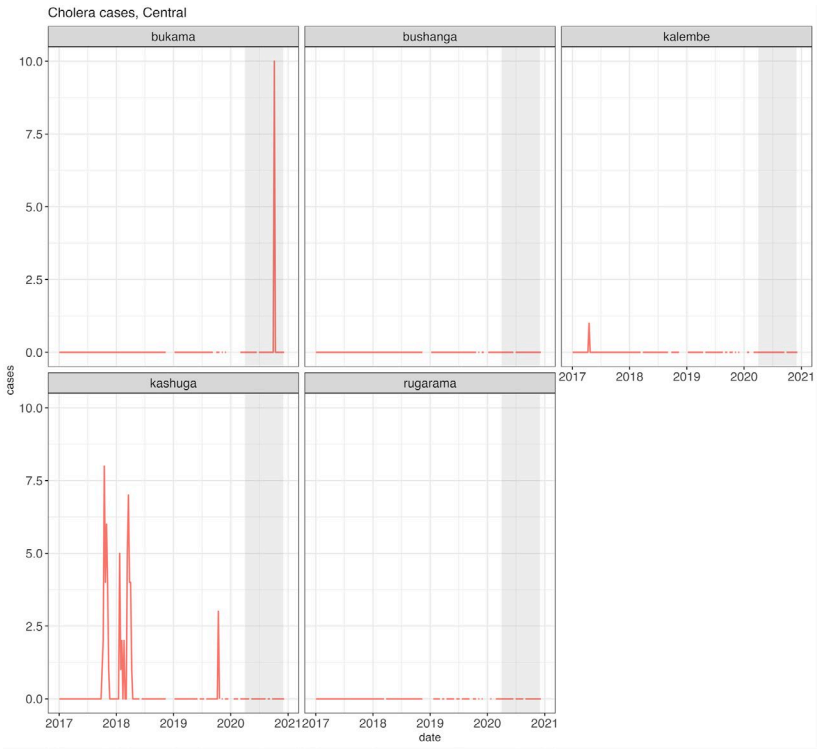

Figure 25: Number of suspected cholera cases in Central subregion, Mweso health zone, DRC, by health area, 2017-2021

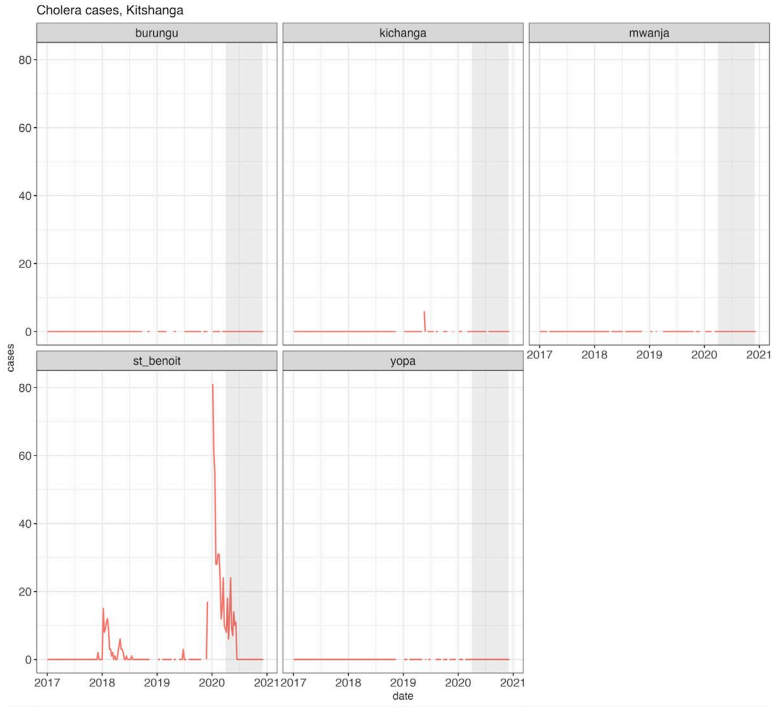

Figure 26: Number of suspected cholera cases in Kitshana subregion, Mweso health zone, DRC, by health area, 2017-2021

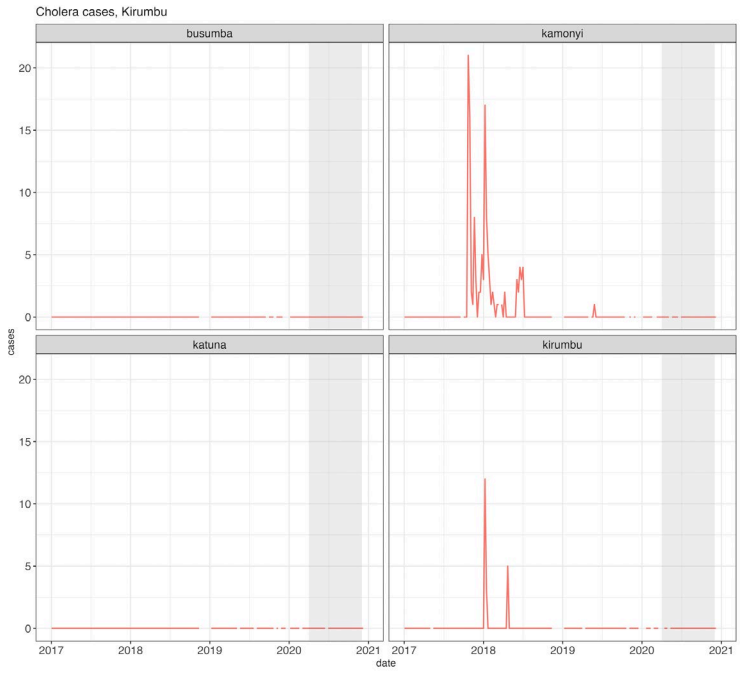

Figure 27: Number of suspected cholera cases in Kirumbu subregion, Mweso health zone, DRC, by health area, 2017-2021

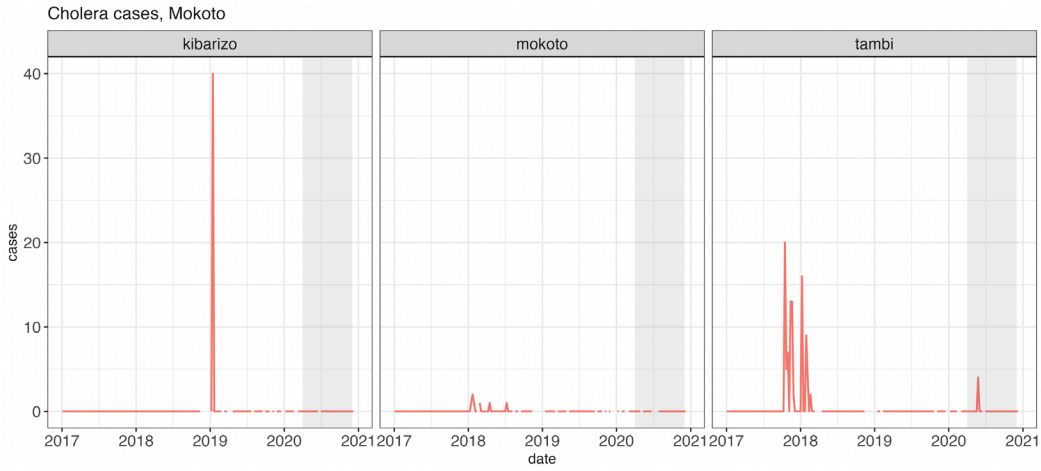

Figure 28: Number of suspected cholera cases in Mokoto subregion, Mweso health zone, DRC by health area 2017.2021

4.2.8 Antenatal care 1st visit

Table 20 summarizes the four outcome variables of the ITS analysis for coverage of first antenatal care visit (ANC1). Mixed results can be seen, with two subregions (Bibwe and Central) reporting a decrease in ANC1 coverage, and three subregions (Kitshanga, Kirumbu, Mokoto) an increase. In Bibwe a 25% decrease at the beginning of the pandemic (IRR: 0.75 [95%CI: 0.576 to 0.978] was followed by a 8% monthly increase in trend (IRR: 1.079 [95%CI: 1.026 to 1.135] during the COVID-19 period. Yet the overall balance was negative (70 consultations less than expected). Increases in the three subregions with positive balance were due to both an increase at the beginning of the pandemic (although none of the estimates is statistically significant) and an increase over time (except for Kitshanga, where the slope is negative but very close to zero) (figure 29). Change in slope in Mokoto is statistically significant and positive corresponding to a 4% increase (IRR: 1.043 [95%CI: 1.005 to 1.082]).

Residuals are largely normally distributed, with exception of a more skewed distribution for Mokoto (Supplement). Large deviations in pre-COVID-19 period correspond to somewhat unusual patterns in individual subregion (figure 30). Individual trends are quite noisy; in Bibwe, for example, in 2018 through end of 2019, ANC1 coverage cycles through values from just below 1 to 3. Still, the deviation in COVID-19 period in Mokoto well exceeds the deviation in the pre-COVID period, so it is unlikely that this difference would be explained by noise alone. For other subregions, results should be interpreted with more caution.

Table 20: Interrupted Time Series results for coverage of first antenatal care visit: immediate change (A), change in slope (B), cumulative difference (C) and percent monthly change (D), by subregion, Mweso health zone, 2017-2021

	A		B		C	D
Subregion	Immediate change		Change in slope		Cumulative difference	Percent monthly change
	Estimate	P-value	Estimate	p-value		
Bibwe	0.75 [0.576 to 0.978]	0.033	1.079 [1.026 to 1.135]	0.003	-70 [-172 to 34]	-2 [-6 to 2]
Central	0.911 [0.716 to 1.16]	0.451	1.01 [0.966 to 1.057]	0.658	-267 [-497 to -10]	-4 [-7 to 0]
Kitshanga	1.136 [0.899 to 1.436]	0.285	0.986 [0.943 to 1.032]	0.556	284 [192 to 381]	9 [6 to 12]
Kirumbu	1.07 [0.874 to 1.309]	0.513	1.021 [0.982 to 1.062]	0.296	346 [289 to 405]	16 [13 to 19]
Mokoto	1.21 [0.988 to 1.482]	0.065	1.043 [1.005 to 1.082]	0.028	591 [550 to 629]	44 [40 to 48]

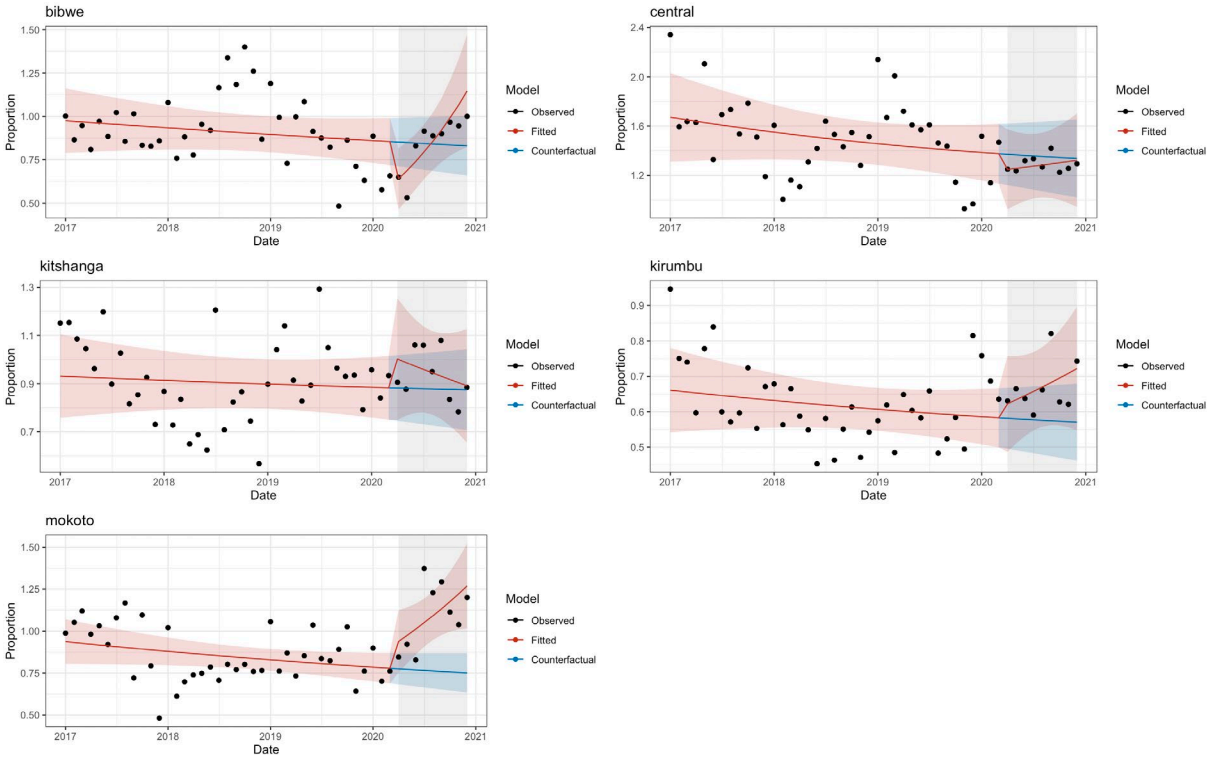

Figure 29: Mean coverage of first visit of antenatal care (proportions): results of ITS analysis showing observed values, fitted model and counterfactual, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

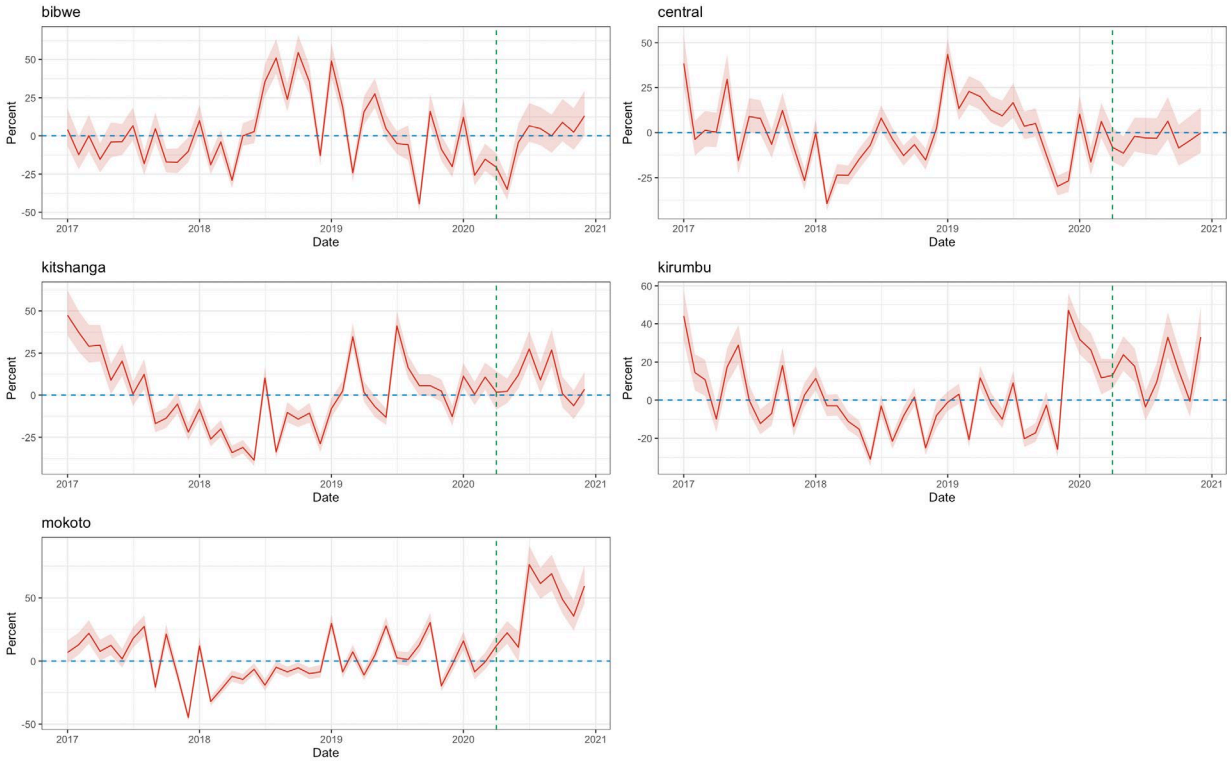

Figure 30: Percent difference between observed and expected values – coverage of first antenatal care visit Jan 1 2017 to March 31 2021, Mweso health zone, DRC

4.2.9 Antenatal care 4th visit

Table 21 summarizes the results of the ITS analysis. Across subregions, a general increase in coverage of Antenatal Care forth visit (ANC4) can be observed: cumulative differences are all positive (ranging from 62 additional ANC4 visits in Bibwe to 478 in Kirumbu); three subregions reported an increase at the beginning of the pandemic, ranging from +4% in Central to +150% in Kirumbu (IRR: 2.494 [95%CI: 1.659 to 3.749]). Changes in slope were close to 1 for Central, Kitshanga and Kirumbu, and positive for Bibwe and Mokoto (IRR: 1.093 [95%CI: 1.033 to 1.165]) (figure 31). Data are mostly normal, although noisy in the pre-COVID-19 period (figure 32). Residuals are skewed for Bibwe while model fit is good for Kirumbu.

Table 21: Interrupted Time Series result: for coverage of fourth antenatal care visit: immediate change (A), change in slope (B), cumulative difference (C) and percent monthly change (D), by subregion, Mweso health zone, 2017-2021

Subregion	A		B		C	D
	Immediate change		Change in slope		Cumulative difference	Percent monthly change
	Estimate	P-value	Estimate	p-value		
Bibwe	0.803 [0.538 to 1.199]	0.283	1.064 [0.985 to 1.149]	0.116	62 [29 to 95]	11 [5 to 19]
Central	1.047 [0.77 to 1.423]	0.771	1.024 [0.967 to 1.084]	0.421	163 [110 to 210]	15 [9 to 20]
Kitshanga	1.325 [0.989 to 1.775]	0.060	1.001 [0.948 to 1.057]	0.960	451 [405 to 496]	39 [34 to 45]
Kirumbu	**2.494 [1.659 to 3.749]**	**0.000**	0.991 [0.919 to 1.068]	0.805	478 [458 to 498]	137 [124 to 153]
Mokoto	0.844 [0.616 to 1.156]	0.290	**1.093 [1.033 to 1.156]**	**0.002**	80 [62 to 97]	23 [17 to 29]

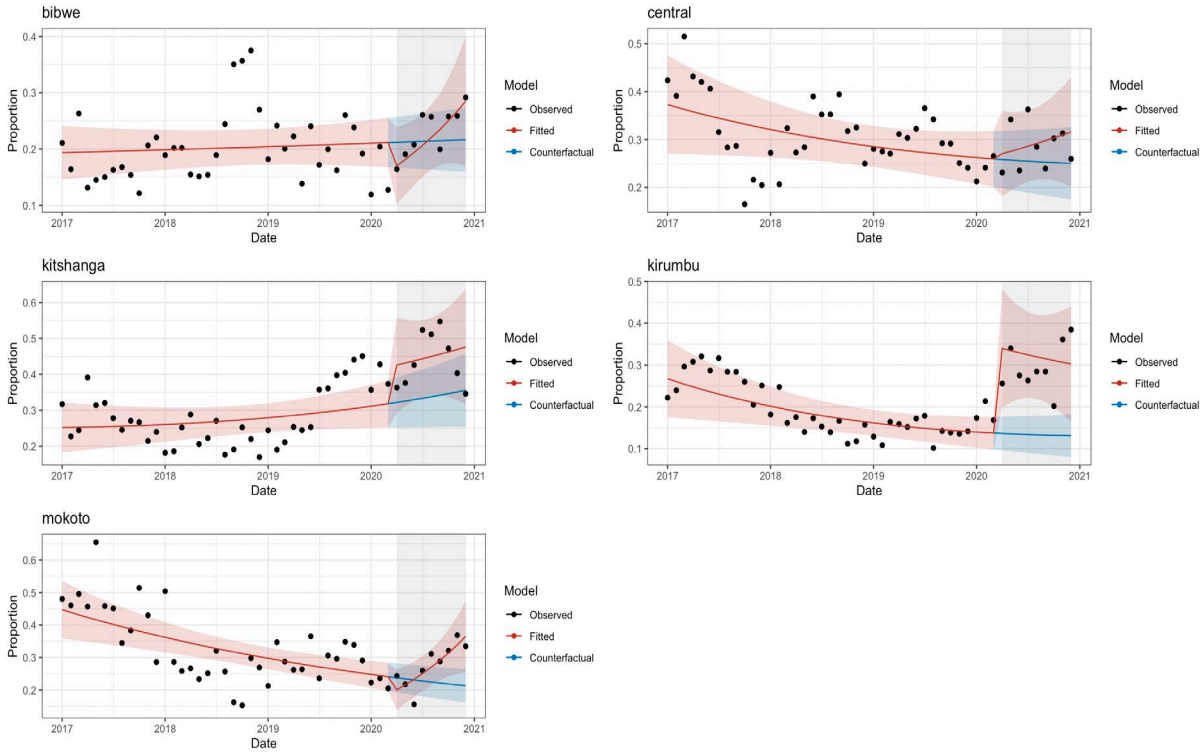

Figure 31: Mean coverage of fourth antenatal care visits: results of ITS analysis showing observed values, fitted model and counterfactual, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

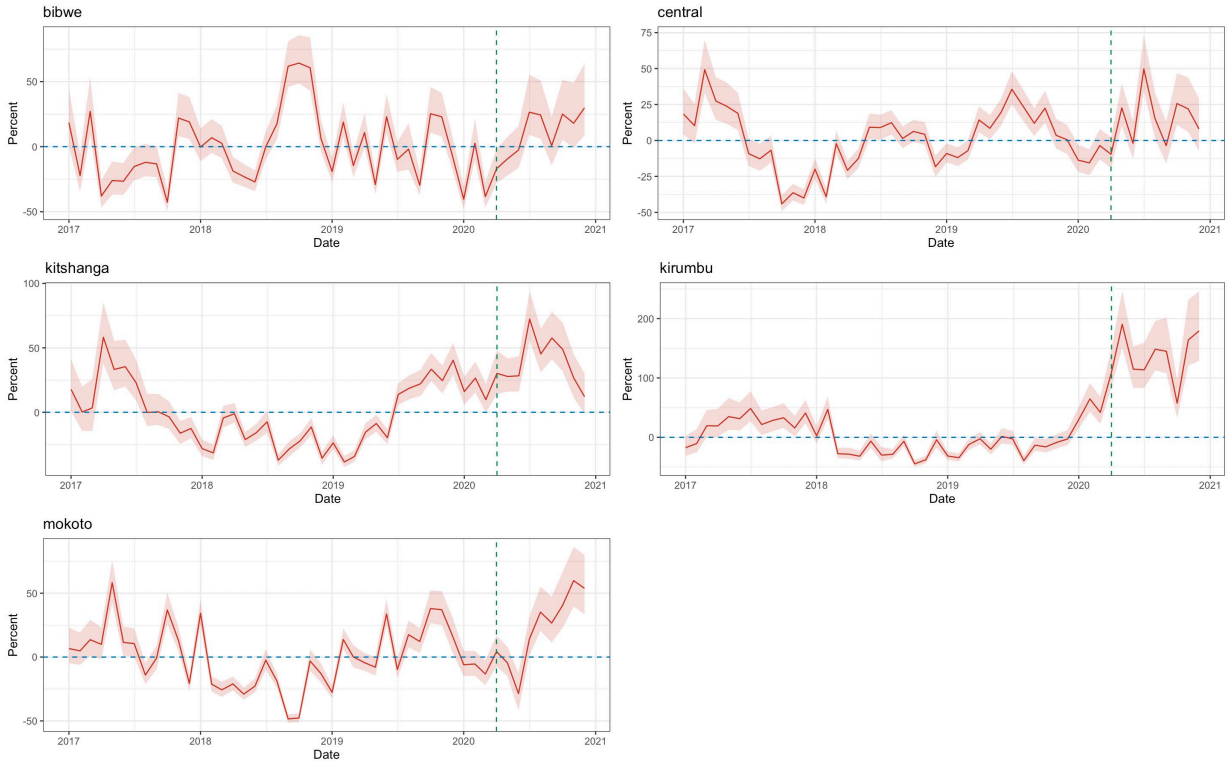

Figure 32: Percent difference between observed and expected values – coverage of fourth antenatal care visit, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

4.2.10 Postnatal care 3rd visit

Table 22 and figure 33 show the results of the ITS analysis. Overall, results seem indicating an increase in coverage of third visit of postnatal care. Three of the five subregions reported an increase at the beginning of the pandemic (although not statistically significant), and three of the subregions reported an increase in slope over time, two of which statistically significant (Bibwe IRR: 1.099 95%CI: [1.001 to 1.206] and Mokoto IRR: 1.105 95%CI [1.026 to 1.19]). Overall cumulative difference is positive and ranges from +2 additional PNC consultations in Central to +171 in Kitshanga.

As for ANC1, the model generally captures the longer term trend pre-COVID-19 period, although it still suffers from data being noisy, resulting in large deviations for some months before beginning of COVID-19 period (figure 34). As for other indicators, Yopa health area (Kitshanga) has an unusual spike in PNC3 consultations in January 2019. Q-Q plots (supplementary material) indicate largely normal data, although we observe larger standard deviation in the histogram of residuals, along with some skew in distribution of residuals in Kitshanga.

Table 22: Interrupted Time Series result for coverage of third postnatal care visit: immediate change (A), change in slope (B), cumulative difference (C) and percent monthly change (D), by subregion, Mweso health zone, 2017-2021

	A		B		C	D
Subregion	Immediate change		Change in slope		Cumulative difference	Percent monthly change
	Estimate	P-value	Estimate	p-value		
Bibwe	0.648 [0.405 to 1.038]	0.071	**1.099 [1.001 to 1.206]**	**0.047**	6 [-8 to 21]	2 [-2 to 6]
Central	1.088 [0.721 to 1.64]	0.689	0.982 [0.911 to 1.059]	0.641	2 [-52 to 53]	1 [-6 to 10]
Kitshanga	1.194 [0.832 to 1.713]	0.337	0.991 [0.926 to 1.061]	0.797	171 [119 to 220]	18 [12 to 24]
Kirumbu	1.452 [0.924 to 2.279]	0.105	1.041 [0.959 to 1.13]	0.334	148 [133 to 163]	76 [63 to 91]
Mokoto	0.773 [0.51 to 1.173]	0.227	**1.105 [1.026 to 1.19]**	**0.009**	33 [17 to 51]	14 [7 to 24]

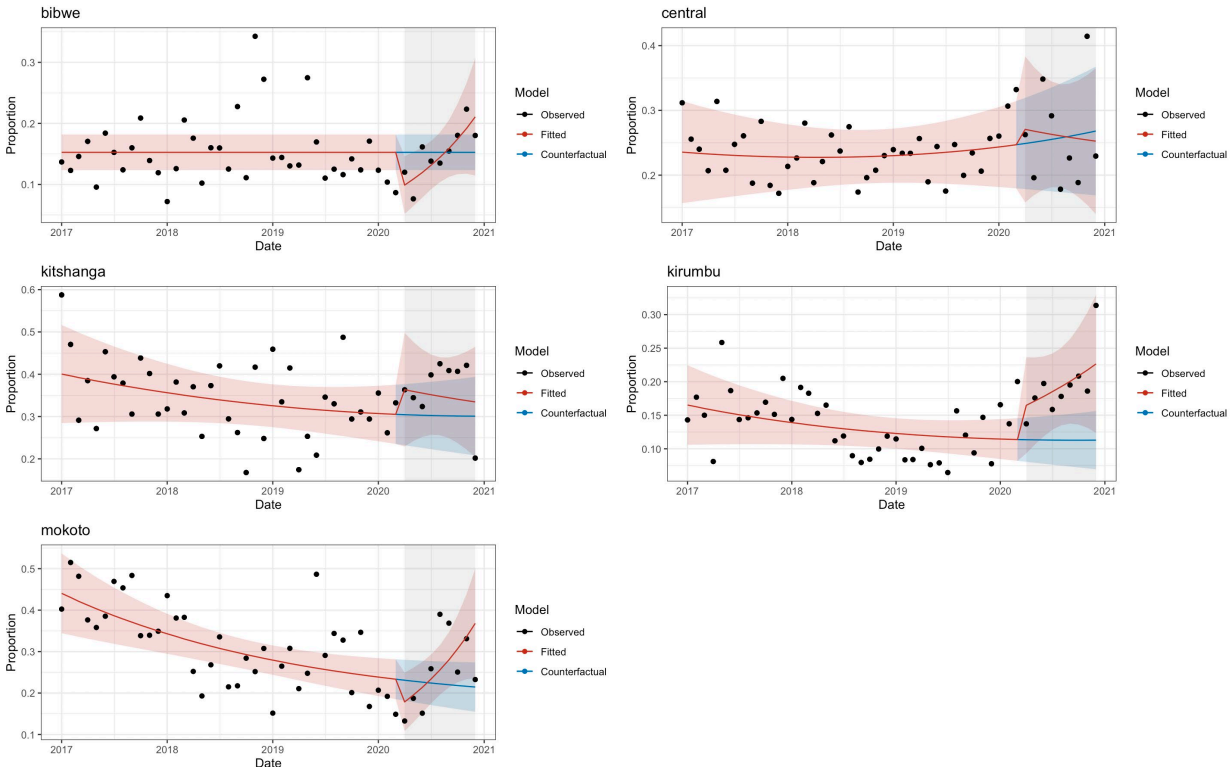

Figure 33: Mean coverage of third postnatal care visits: results of ITS analysis showing observed values, fitted model and counterfactual, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

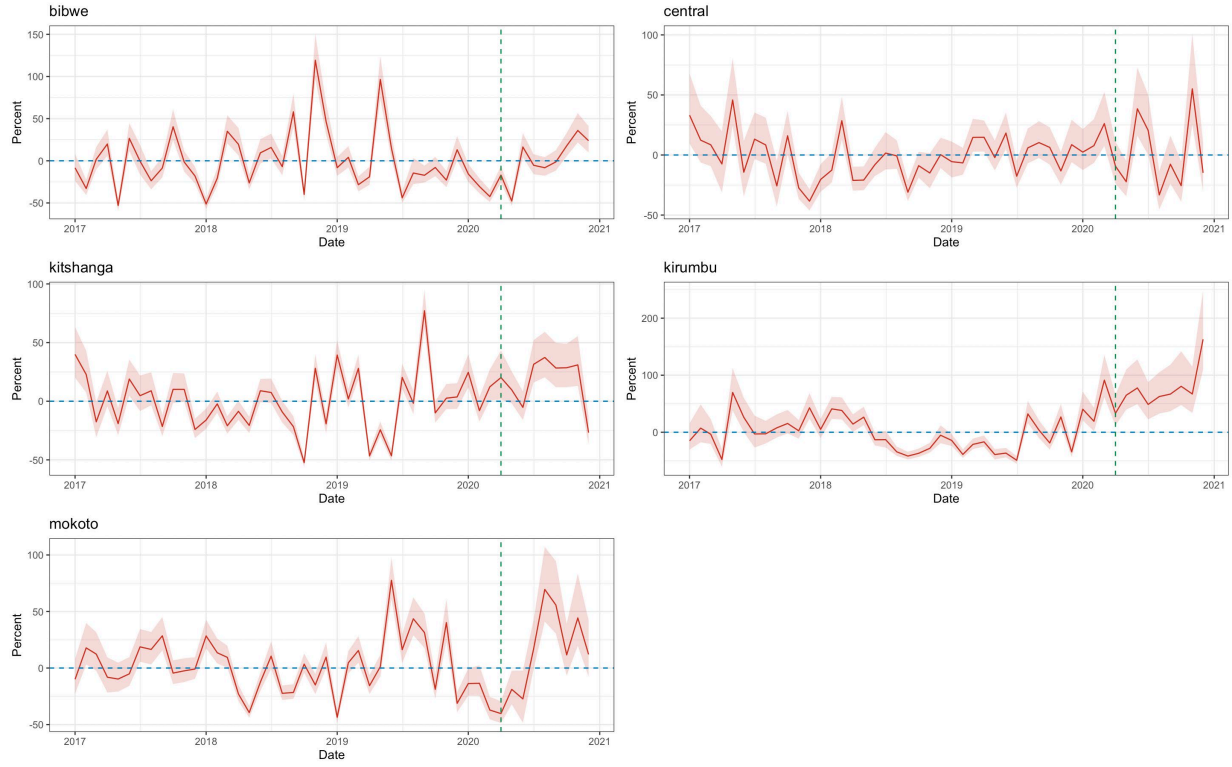

Figure 34: Percent difference between observed and expected values – coverage of third postnatal care visit, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

4.2.11 Institutional deliveries

Table 23 and figure 35 show the results of the ITS. An absolute increase in institutional deliveries is reported in all subregions (ranging from 142 in Central to 601 in Kitshanga). This is reflected in most subregions recording positive coefficients for immediate changes at the beginning of the pandemic (except for Bibwe). A 86% increase was found in Kirumbu (IRR: 1.866 [95%CI: 1.385 to 2.514]). Changes in slope are either close to zero (Central and Kirumbu) or positive. In Mokoto, the change in slope corresponds to a 6% increase (IRR: 1.063 [95%CI: 1.02 to 1.108]).

Similar to other indicators, the models overall capture longer-term trends, but the data are quite noisy (figure 36). Residuals are close to normally distributed for Central. For other subregions, residuals are not well normally distributed. Generally, the model did not well capture highest values of deliveries (it tended to underestimate them).

Table 23: Interrupted Time Series result for coverage of institutional deliveries: immediate change (A), change in slope (B), cumulative difference (C) and percent monthly change (D), by subregion, Mweso health zone, 2017-2021

	A		B		C	D
Subregion	Immediate change		Change in slope		Cumulative difference	Percent monthly change
	Estimate	p-value	Estimate	p-value		
Bibwe	0.967 [0.731 to 1.279]	0.815	1.056 [0.999; 1.117]	0.056	144 [117 to 172]	13 [11 to 16]
Central	1.137 [0.894 to 1.447]	0.295	0.971 [0.928 to 1.016]	0.197	142 [-171 to 436]	3 [-2 to 9]
Kitshanga	1.261 [0.858 to 1.852]	0.238	1.025 [0.954 to 1.102]	0.498	601 [484 to 713]	33 [25 to 41]
Kirumbu	**1.866 [1.385 to 2.514]**	**0.000**	0.95 [0.897 to 1.006]	0.082	484 [446 to 521]	55 [49 to 63]
Mokoto	1.105 [0.884 to 1.382]	0.381	**1.063 [1.02** to **1.108]**	**0.004**	325 [303 to 346]	43 [39 to 47]

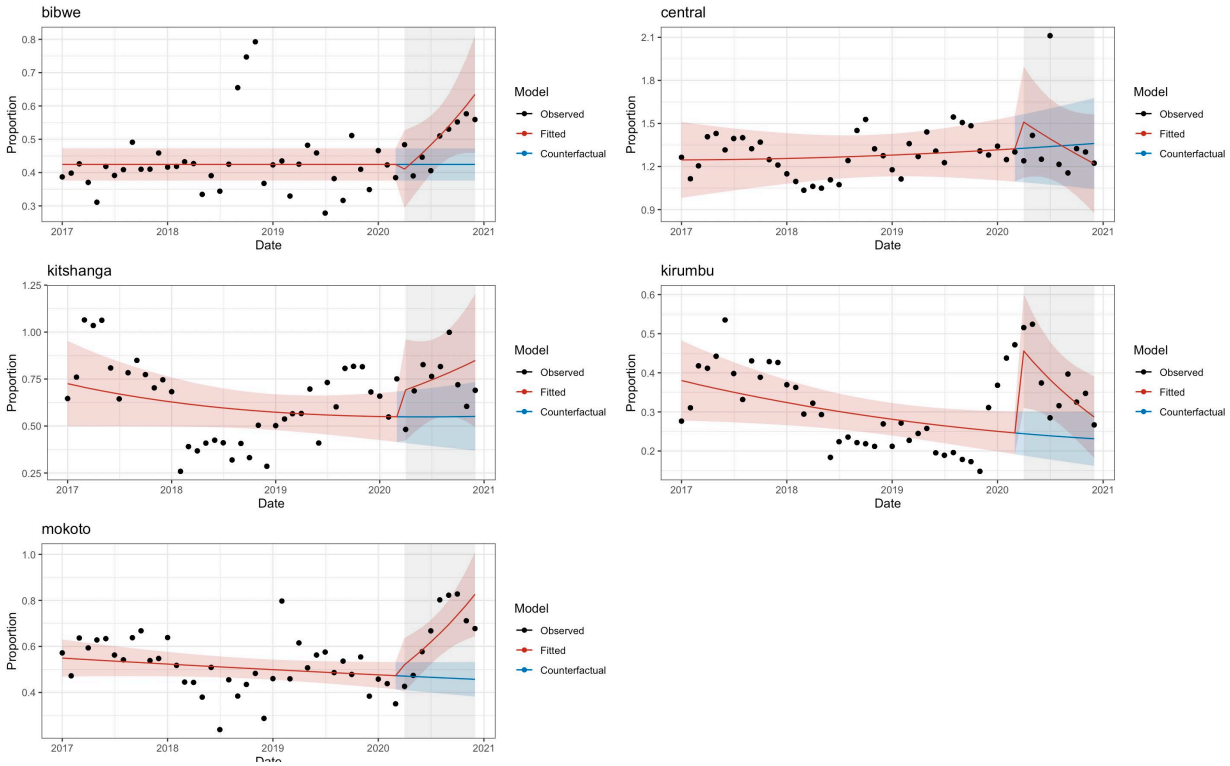

Figure 35: Mean coverage of institutional deliveries: results of ITS analysis showing observed values, fitted model and counterfactual, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

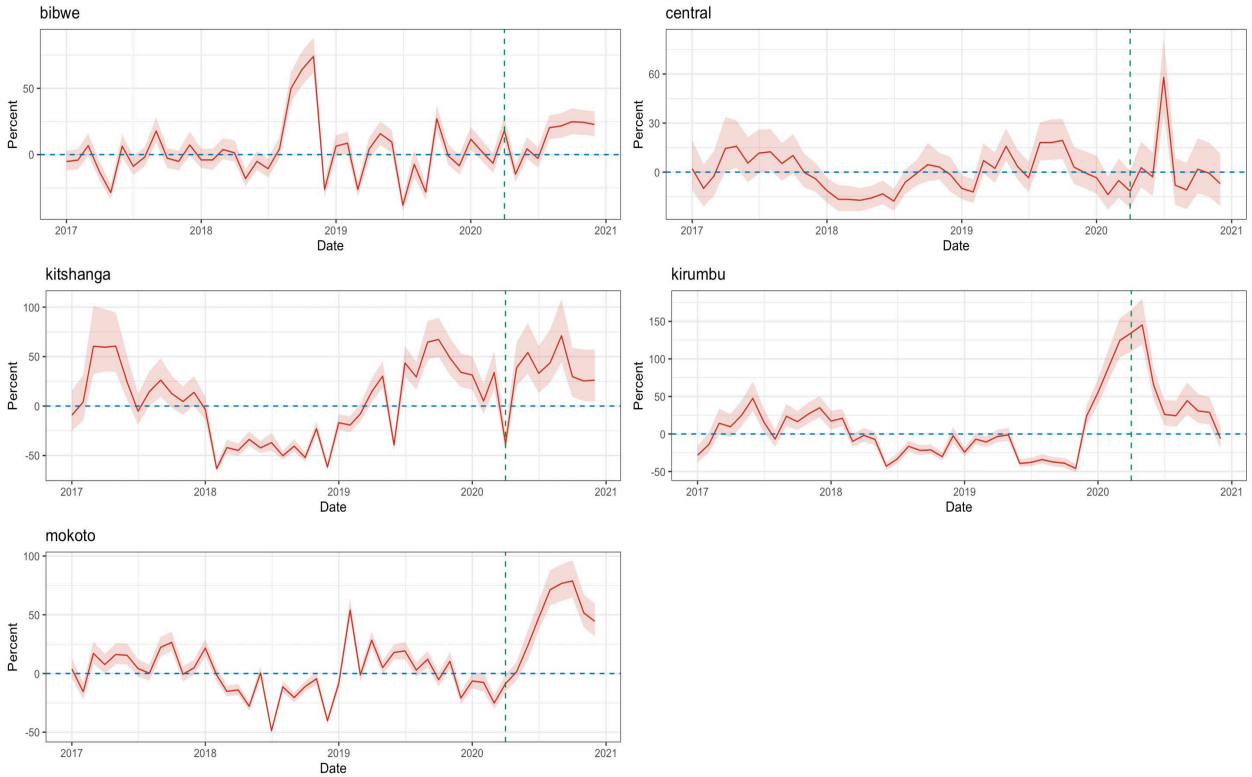

Figure 36: Percent difference between observed and expected values – coverage of institutional deliveries, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

4.2.12 Measles vaccination

DVDMT data were used to investigate changes in coverage of measles vaccine as program data were deemed more reliable and timelier than routine health service data (SNIS). Sensitivity analysis (supplementary material) was conducted with SNIS data.

Results are shown in table 24 and figure 37. All subregions reported a decrease in delivered vaccine doses at the beginning of the pandemic, ranging from a 9% decrease in Kitshanga (IRR: 0.912 [95%CI: 0.802 to 1.038]) to a 1% decrease in Kirumbu (IRR: 0.995 [95% CI: 0.881 to 1.124] (table 24). Changes in slope were also negative, except in Mokoto, although very close to zero. Cumulative differences (table 24) for four of the five subregions are also negative, ranging from -92 measles doses distributed in Kirumbu to – 508 in Kitshanga. Monthly percent change ranges from -14% to +1%. Mokoto reported both a positive cumulative difference and a positive average monthly change (figure 38). Although the results are not statistically significant, they consistently indicate a decrease in vaccination coverage. While data are not normally distributed, with exception of Mokoto, which comes close, the model fit is overall good. Residuals are skewed for Mokoto. There is some mild skew in other subregions.

Table 24: Interrupted Time Series result for coverage of measles vaccine: immediate change (A), change in slope (B), cumulative difference (C) and percent monthly change (D), by subregion, Mweso health zone, 2017-2021

	A		B		C	D
Subregion	Immediate change		Change in slope		Cumulative difference	Percent monthly change
	Estimate	P-value	Estimate	p-value		
Bibwe	0.972 [0.787 to 1.201]	0.795	0.995 [0.956 to 1.035]	0.790	-125 [-191 to -55]	-5 [-8 to -2]
Central	0.925 [0.799 to 1.071]	0.298	0.998 [0.971 to 1.026]	0.896	-246 [-312 to -183]	-7 [-8 to -5]
Kitshanga	0.912 [0.802 to 1.038]	0.162	0.985 [0.962 to 1.01]	0.236	-508 [-569 to -449]	-14 [-16 to -13]
Kirumbu	0.995 [0.881 to 1.124]	0.936	0.995 [0.972 to 1.018]	0.666	-92 [-138 to -47]	-3 [-4 to -2]
Mokoto	0.959 [0.86 to 1.068]	0.446	1.014 [0.993 to 1.034]	0.187	21 [-2 to 44]	1 [0 to 3]

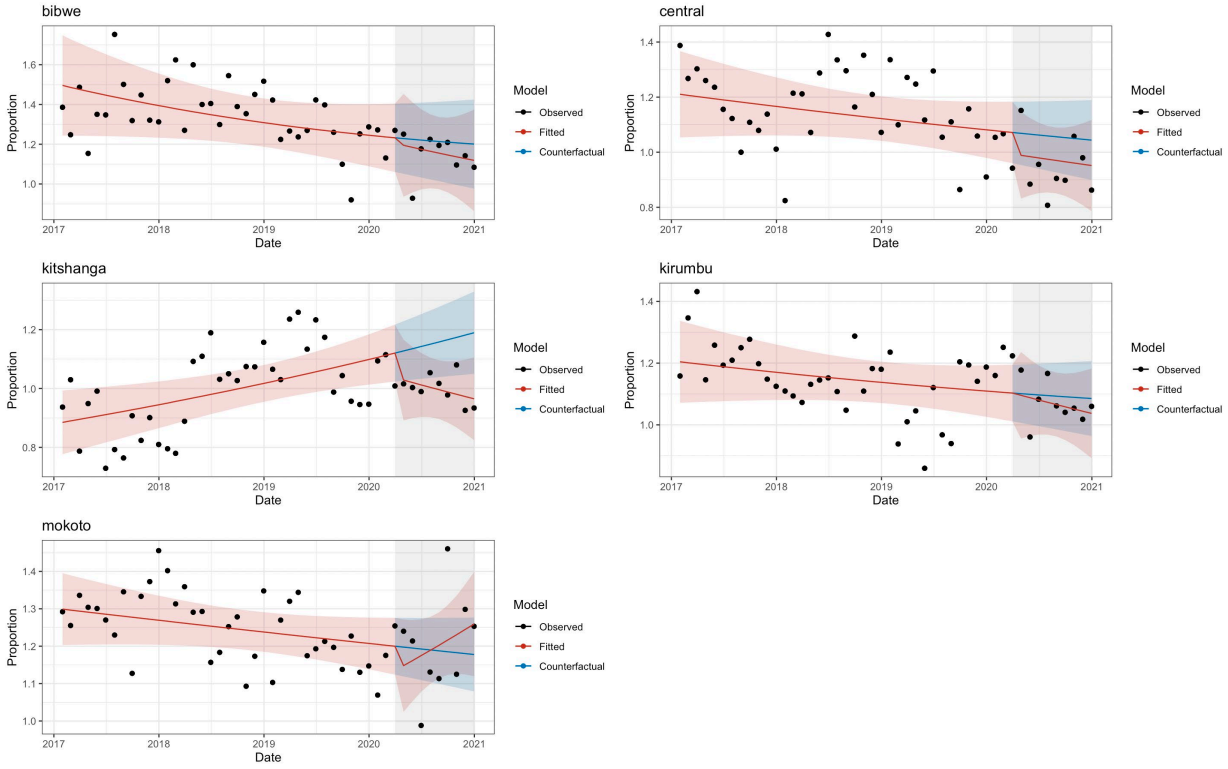

Figure 37: Mean coverage of measles vaccine: results of ITS analysis showing observed values, fitted model and counterfactual, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

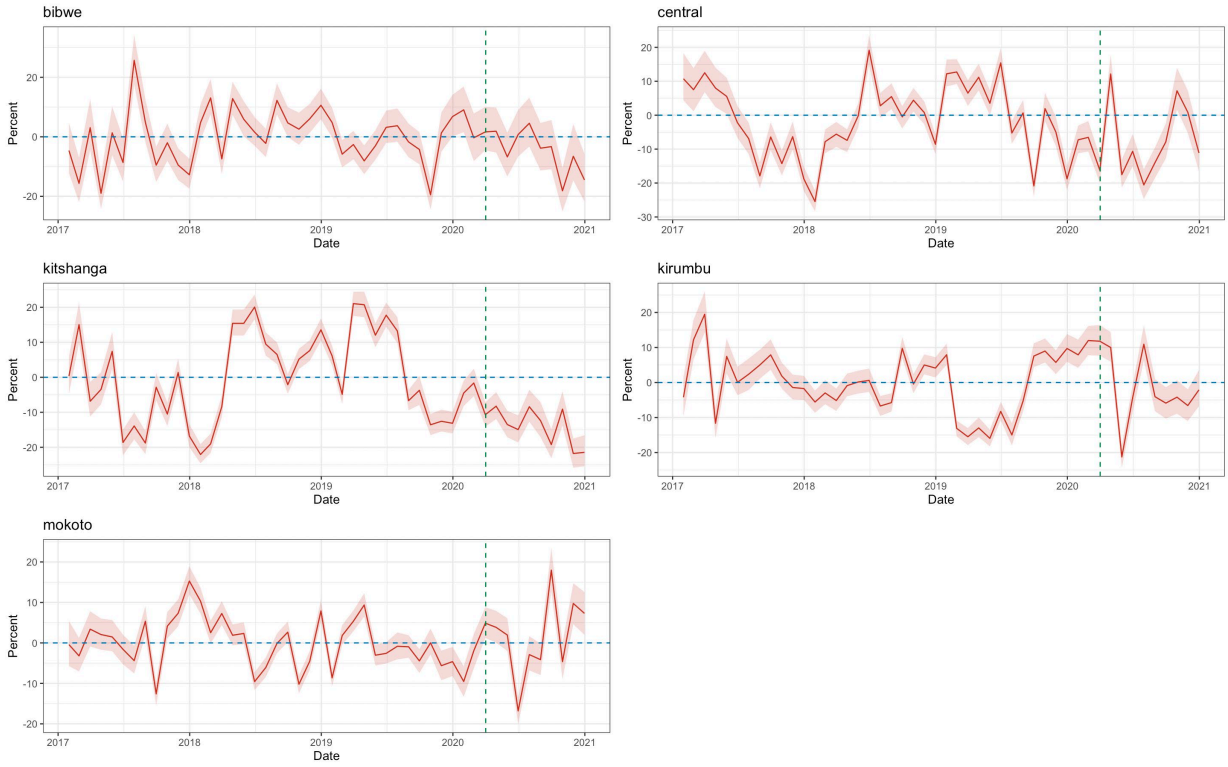

Figure 38: Percent difference between observed and expected values – coverage of measles vaccination, Jan 1, 2017 to March 31, 2021, Mweso health zone, DRC.

4.3 Health care workers' perceptions

4.3.1 Key results

- Most health care workers reported a decrease in reproductive health, maternal and newborn health, and child health services.
- Results were mixed for child nutrition services and hospital based care with about half of respondents saying there was no change while others reported a decrease in services.
- The only areas where there was no perceived change was referrals, laboratory services, and care for sexual and gender-based violence (SGBV).
- Community outreach services were reported as reduced or stopped altogether.
- Non-communicable disease services were momentarily suspended in the centers that offered these services.
- Drug availability was decreased as reported unanimously by all health care workers.
- Infection prevention and control (IPC) measures were implemented in the majority of the health facilities, but stockouts and limited access to water represented a challenge to IPC. Health care workers reported negative attitudes of the population vis-à-vis IPC measures.
- Closing of schools and churches, limiting the number of people at gatherings, restricting people's movement, and wearing of masks were reported as the most predominant public health measures put in place in response to the COVID-19 pandemic.

4.3.2 Participant profile

The majority (79%) of the healthcare professionals interviewed were male (31). Approximately one third were nurses (15) and there was a wide range of other professionals interviewed (table 25).

Table 25: Profile of respondents to the qualitative interview on health care workers perceptions, DRC

Occupation	Number of respondents (n=39)
registered nurses	15
deputy nurses	5
midwives	3
nutritionists	3
pharmacy attendants	2
receptionists	2
attending physicians	2
assistant nurse	1
birth attendant	1
pharmacist	1
pharmacy manager	1
director of nursing	1
chief of staff	1
chief of emergency	1

4.3.3 Context

Healthcare professionals reported that the following measures were the most predominant forms of public health control put in place between March 2020 and July 2020 in response to the COVID-19 pandemic: closing of schools and churches, limiting the number of people at gatherings, and restricting people's movement, and wearing of masks. Other events that impacted health service provision in Mweso health zone since January 2019 include population displacement and insecurity (table 26). As mentioned above, insecurity and population displacement has affected North Kivu and Mweso for decades.

Table 26: Public health measures and other major events affecting Mweso health zone, DRC

COVID and Public Health Measures	Other Events
• Wearing masks (14) • Physical/social distancing (9) • Handwashing (8) • Closure of schools and churches (38) • Restricting the number of people at gatherings (36) • Restricting mobility (27) • Enforcing barrier measures (3) • Installing handwashing stations (2)	• Population displacement (37) • Insecurity (34) • Demonstrations against kidnappings (9) • Cholera outbreak (3) • Measles outbreak (7)

4.3.4 Changes and adaptations by health service

Reproductive health

Most healthcare professionals reported that family planning services and consultations decreased in January 2021 in response to the COVID-19 pandemic mainly as a result of the absence of local partners, stockouts of relevant commodities, and population displacement. Less common reasons for this reduction in family planning services and consultations include fear of preventative measures, fear of COVID-19 infection, and the fact that these services are seen as non-essential.

While several health workers did not notice any changes in this service, a few other healthcare professionals reported an increase in family planning services and consultations in February 2020 and January 2021 at the beginning of the COVID-19 pandemic as a result of informing patients about these services and population displacement.

Maternal and newborn health

Most healthcare professionals reported that maternal and newborn services, including deliveries (routine and emergency) and ante-natal/post-natal consultations (ANC and PNC), decreased at the beginning of the pandemic mainly as a result of the absence of local partners, fear of being vaccinated against or contaminated with COVID-19, fear of having to wear masks, fear of being billed for these services. Insecurity and population displacement were also reported as a cause of decreased access to care. Other healthcare professionals reported an increase in maternal and newborn services and cases thanks to

increased availability of human resources, the presence of partners supporting the health facility, and free health services provided by the partners.

Child health services

Most healthcare professionals reported that prevention and treatment of diseases such as malaria, diarrhea, and acute respiratory infection (ARI), as well as growth monitoring and promotion (GMP) and vaccination rates, decreased in June 2020 in response to the COVID-19 pandemic. Reasons for this decrease include fear that children would be vaccinated against COVID-19, insecurity, population displacement, lack of masks, vaccine stockout and the absence of local partners. Other healthcare professionals reported an increase in GMP and vaccination services and cases of malaria, diarrhea, and ARI in April 2020 linked to increased availability of human resources.

Child Nutrition

Around half (44%) of the healthcare professionals reported that child nutrition services, including the management of moderate acute and/or severe malnutrition on an outpatient basis, were not impacted by the COVID-19 pandemic at their health facilities. Around a third (36 %) reported that these services decreased in response to the COVID-19 pandemic mainly as a result of the absence of local partners and stockouts of relevant commodities (including plumpinut). In some cases, a complete termination of services occurred due to the departure of ACF. Other healthcare professionals reported changes in treatment regimen/dosage, supply/stock, and prescription methods due to stockouts and other supply chain disruptions.

Communicable and non-communicable diseases

Most healthcare professionals reported that treatment and screening of communicable diseases such as malaria, HIV, and tuberculosis among adults was not impacted by the COVID-19 pandemic at their health facilities. A few healthcare professionals reported that cases of these communicable diseases decreased and services were reduced in May 2020 in response to the COVID-19 pandemic mainly as a result of stock outs of relevant commodities.

Most healthcare professionals reported that treatment and screening of diabetes, cardio-vascular disease, and other non-transmissible diseases was not offered at their health facilities. However, of those who offered services the majority (60%) reported that these activities were momentarily suspended in June and August 2020 due to compliance with barrier measures and stock outs of relevant commodities (including anti-diabetic medications).

Laboratory and pharmacy

The majority of healthcare professionals reported that laboratory capacity for COVID-19 and other disease (e.g., malaria, HIV/AIDS, etc.) was not offered at their health facilities. Among the respondents from health facilities where laboratory services were offered, several reported no changes, and a few other mentioned stockout of laboratory supplies.

Every healthcare professional surveyed reported a change in drug availability in response to the COVID-19 pandemic. Most healthcare professionals reported that drug availability was affected by changes in supply chain mode and frequency of delivery caused by border closings or lockdowns in March 2020. This

led to medication stockouts. Other healthcare professionals reported that drug availability was affected by changes in medication prices already since before the pandemic mainly due to medication stockouts.

Referral cases

Most healthcare professionals reported no changes to the frequency of and reason for referrals from health facilities to hospitals in response to the COVID-19 pandemic. Some healthcare professionals reported an increase in frequency and number of cases of referrals due to stockouts of medications /relevant commodities and limited services. Other healthcare professionals reported a decrease in frequency of referrals as patients refused to go to the hospital (or travel any distance) for fear of being infected with COVID-19.

Hospitalizations

The majority of healthcare professionals did not provide a response to this survey question. Of the healthcare professionals that did respond, about half reported no change in hospital-based care for internal medicine, pediatric and neonatal care, obstetric and gynecology care (OBGYN), and surgery services during the COVID-19 pandemic. The rest indicated that there had been a decrease mainly due to the departure of technical partners supporting the health facility, patients' incapacity to pay medical bills and insecurity.

Community outreach

The majority of healthcare professionals reported that community activities including trainings, meetings (including Health Area Development Committee meetings), home visits, and community health workers visits, or awareness activities were reduced or stopped altogether in response to the COVID-19 pandemic. In some cases, the number of people allowed in a meeting was reduced, and the number of meetings increased. This was a result of orders given by local government authorities, insecurity, compliance with preventative measures, and for protection against COVID-19.

Sexual and Gender Based Violence

The majority of healthcare professionals (19/39) reported no changes to SGBV care in response to the COVID-19 pandemic. Some healthcare professionals reported an increase in frequency and number of cases (9/39) of SGBV at the beginning of the COVID-19 pandemic mainly as a result of recurrent or permanent insecurity. Other healthcare professionals reported a decrease in frequency and number of cases (7/39) of SGBV during 2020 due to the absence of local partners and stockouts of the PEP Kit.

Infection Prevention and Control Measures

The majority of healthcare professionals reported that the following infection and prevention control (IPC) measures were implemented in their health facilities: physical distancing, temperature checks, triage of patients, mask wearing, installation of handwashing stations, handwashing, isolation of suspected cases, training on IPC measures and other preventative measures, and the provision of personal protective equipment (PPE). Other prevention and control measures include the addition of benches for physical distancing between patients, wearing gloves, accompanying patients and healthcare professionals, and having a water source for handwashing. The majority of healthcare professionals reported that the following challenges occurred at their health facilities that affected the implementation of IPC measures:

stockouts of PPE, insufficient quantities of PPE, insufficient handwashing stations, and no isolation areas. Other challenges include insufficient water available, no triage capacity, and medication stockouts.

Most healthcare professionals reported that the perception of the population to IPC measures was generally negative. Professionals believed that the population thought the measures were embarrassing, unremarkable, useless and annoying. Many professionals reported non-adherence or gradual adherence to these measures with only a few professionals reporting that measures were already being adhered to. Several professionals reported that the population was resistant to the measures and does not believe that COVID-19 exists, while others reported that the population understands the importance of the measures and believes they can help reduce the spread of the pandemic. Some professionals reported the population believing nurses benefit from wearing PPE and require others to wear PPE.

4.3.5 Summary of health care workers' perceptions

A decrease in consultations for reproductive, maternal and child health was reported by the majority of the interviewed health care workers. Less affected were infectious diseases and NCD services, laboratory, referrals, and hospitalizations. Stockouts of medicines and therapeutic food for malnourished children were common. Community based activities were drastically reduced or interrupted. Insecurity and population displacement affected service delivery before the beginning of the COVID-19 pandemic.

Table 27 summarizes the main changes highlighted during the interviews. Causes for a change are listed according to how frequently they were reported (from most to least frequent).

Table 27 : Summary of reasons for changes in health care services

	Reason for change	Affected groups or services
Increase in services, consultations, and/or service providers	• Informing patients of services • Population displacement • Increased availability of human resources • Presence of partners • Free health services from partners • Medication stockouts • Stockouts of relevant commodities • Limited services • Strengthen the team • Support triage	RH patients MNCH patients Child preventative health Referrals SGBV patients Child and pregnant women consultation groups
Decrease in services, consultations, and/or service providers	• Absence of partners • Stockouts of relevant commodities • Population displacement • Fear of being vaccinated against COVID-19/ Fear that children would be vaccinated against COVID-19 • Fear of being infected with COVID-19/ Refusal to go to the hospital (or any great distance) for fear of being infected with COVID-19	RH patients MNCH patients Child preventative health Child nutrition Adult communicable disease Referrals SGBV patients

	• Fear of wearing masks • Fear of being billed for these services/ Medical bill payments/ Paying out of pocket for services • Insecurity • Lack of masks and other PPE • Stockouts of the PEP Kit • Orders given by local authorities • Compliance with preventative measures • Protection against COVID-19 • Dissatisfaction with salary and treatment	Hospitalizations All consultation groups

How consultations have changed during COVID-19

Most healthcare professionals reported that consultations decreased during COVID-19 as a result of population displacement, insecurity, absence of local partners, and medication stockouts. At most facilities, all categories of patients were affected but adults (especially men) were more impacted than children.

One of the underlying reasons for the decrease in consultations during COVID-19 was because patients were expected to pay for services and were unable to. As a result, many patients sought care from traditional healers, pharmacies, or the nearby hospital where free services were provided. For example, a deputy nurse at a health post reported that there was a decrease in the number of consultations at their health facility because "people came less [frequently] to the health post because the care is payable [and so] they went to traditional healers and pharmacies [instead]".

Another underlying reason for the decrease in consultations during COVID-19 was because the population was displaced by insecurity and had to seek care at facilities near where they had taken refuge. For example, a nutritionist reported that there was a low attendance rate at their health facility because the local population was displaced by insecurity and "oriented themselves towards the health facilities close to their place of flight". Fear of preventative measures, fear of being infected with COVID-19, and fear of being vaccinated against COVID-19 also contributed to the decrease in consultations.

How health personnel who work in the health facility have changed during COVID-19

Most healthcare professionals reported that the number of service providers working at their health facilities increased since the onset of COVID-19. Many healthcare professionals reported that there were no changes to the number of service providers working in the health facility since the onset of COVID-19. Other healthcare professionals reported that service providers were reassigned to other teams at their health facilities during COVID-19 in order to support triage, though not all posts were affected in the same way.

Perception of the population to the changes

The majority of healthcare professionals reported that the reaction and perception of the population to the changes in health service delivery was generally negative. Professionals believed that the population was not satisfied with the changes due to the fact that they were not receiving adequate, or quality

treatment and treatment was difficult to access. Other professionals reported that the population was frustrated with mask mandates or believed that the COVID-19 virus does not exist. Most professionals reported that the population struggled to adapt to the changes and to barrier measures, with a few professionals reporting that the population adapted later on. A few professionals reported that they believed the population does not understand the cause of the changes.

4.4 Health care seeking behavior and social interactions

Results from the HH survey and the focus group discussions are presented combined by theme. Each section includes a summary of the quantitative and of the qualitative findings, as well as key quotes from the FGDs. All results in the tables including confidence intervals are available in electronic format upon request.

4.4.1 Key results

General knowledge and perceptions

- All respondents were aware of COVID-19.
    - Good understanding of risks of contracting COVID-19.
    - Low understanding of who is most susceptible.
    - Elderly were less well informed.
    - No significant difference based on sex, displacement status or rural/urban
- Concept of asymptomatic cases not well understood.
- A minority expressed that COVID-19 was a made-up disease invented by power to make money or by whites to eliminate blacks.
- Impact on daily life was significant due to closures and movement restrictions.
- Reported increase in the activities of armed groups, youth banditry, and police harassment.

Knowledge and reported practice of preventative measures

- Knowledge of reported measures to prevent COVID-19 was correct: wearing a mask, hand washing, reduce contact, and physical distancing.
    - A minority of those at risk say that praying is a means of reducing the risk of contracting COVID-19.
- Reported practice was not high: only half of the respondent report wearing a mask and less than half are maintaining physical distance.
    - Displaced people had the most trouble maintaining physical distance.
    - However, handwashing practices are fairly high – less women, urban and people at risk practiced this measure. It was said to be the most applied because it protects against several other disease and not because of COVID-19.
- Behavior change was motivated by avoiding law enforcement and fines and avoiding COVID-19.
- Practices decreased over time.
- Access to protective measures such as soap and masks limited by supply and financial barriers.

Information sources

- Radio was the most common source of information and considered the most reliable, followed by information from health workers in health facilities.

- There were some disparities amongst groups.
    - The elderly and women relied more on their surroundings and community/religious leaders for information than others.
    - People living in rural areas relied on the radio less and accessed slightly more information from health facilities.
- All groups expressed facing obstacles in accessing reliable information on the pandemic and prevention measures primarily due to poverty and lack of resources to buy a radio or telephone.
- Rumors about how to prevent COVID-19 were not common nor put into practice. However, rumors to treat COVID-19 were common such as drinking local and strong alcoholic beverages (e.g., rutuku), consulting traditional practitioners, and to put a hair in the water and drink this water.

Vaccination

- Half of the respondents were willing to get vaccinated against COVID-19 (probably or very probably).
    - More men than women were willing.
    - There was no difference between the age groups.
    - There was geographic variation.
    - Rural populations were more willing to get vaccinated than urban.
- Reasons given for not being willing to get vaccinated are:
    - Need for more information about the vaccine and side effects
    - Rumors such as the vaccine can kill people, can control the body, is satanic, can disable, or can cause the body to bloat.

General health care seeking behaviors

- The average age of those who were sick was 15 years old. Women were more often sick than men. Rates of sickness were higher for the elderly and persons at risk.
- The most common symptoms were fever, chronic headaches or cough.
- Most respondents reported seeking treatment or advice.
    - Men and displaced people sought care less than other groups, and there was geographical variation
- The biggest barrier to seeking care was finances while lack of facilities and drugs was also an issue. Trust did not seem to be an issue.
- Health centers were the most common place for treatment.
    - Rural residents and women preferred health centers the most.
    - There is geographic disparity.

Health care seeking behaviors in the first months of COVID-19

- Health care seeking behaviors did not change during the beginning of the pandemic.
- Fever, cough and chronic headaches continued to be the most common symptoms of illness – with geographic variation.
- Almost all respondents sought assistance when they felt sick with no gender or displacement based variations.
    - Persons at risk sought care less frequently than others.
- Health centers continued to be the most common place for seeking care.
    - Natural medicines, mobile clinics, and private doctors were uncommon responses.
    - Displaced people sought care more frequently from natural healers.

- Routine vaccinations were not interrupted.
    - A quarter of those who didn't vaccinate their children cited fear of COVID-19 infection; concern was more common in men and urban populations.

Social Interactions

- All groups reproted the number of people in the household was high during the pandemic because of the closure of schools and work.
- Most people reported a decrease in frequency and duration of meetings during the months of COVID-19 restrictions (March to August 2020). 1 in 4 people did not report any change to their social interactions.
- The majority of people worried about social interactions, but these interactions were perceived as inevitable. However, half of people reported meeting others for leisure. The elderly were avoided so as not to transmit COVID-19 to them.
- Most people reported daily interactions.
    - The majority of respondents had 1-2 interactions per day, mostly with a friend in a home setting or household member.
    - Men interacted with friends more than women and had more interactions walking or at work.
    - Interactions were short (15min -1 hour)
    - The majority of respondents report no one in the interaction to be wearing a mask.
    - Almost all interactions included physical contact.
    -

Access to WASH

- Access to handwashing devices increased during the pandemic.
- Yet over half of the respondents did not have access to a functional handwashing device and less than a third had a function device at home.
    - The elderly and disabled had the least access.
    - Rural populations and boys/men had less access than urban and girls/women.
    - Access to WASH varied depending on geographic area.
- Most respondents reported washing their hands more often during the pandemic although persons at risk and the elderly showed less change in behavior.
- Washing hands was reported as common after the toilet, before eating, after changing diapers because it protects other disease (such as diarrhea and cholera) and not because of COVID-19.
- Greatest challenge to accessing a function handwashing device was prohibitive cost of soap or water.
    - The displaced and rural were most affected by these challenges.
    - The elderly and at risk had additional challenges such as the distance to the water point being too great.

4.4.2 Respondents' profile

For the qualitative data, 110 people (55 men and 55 women) were interviewed (table 28) between the ages of 18 and 60+ years.

For the quantitative data, in total 657 household interviews were conducted. Tables 29-30 include overall characteristics of survey respondents. Most respondents were from rural areas (79%) and the majority (84%) were adults between 18-45 years. There were double the number of women respondents (67%)

than men (33%). The majority (76%) were residents and almost all (99%) were Christian. Agriculture (74%) is the main source of income with women slightly more represented than men (76% versus 65%). Overall, almost half of respondents (46%) reported no education and only 2% reported university education level.

Table 28: Focus group details, Mweso health zone, North Kivu, DRC (November 2021)

	Sex	Number of participants	Age category	Health zone	Settlement
FGD 1	Women	8	31 – 59	Mweso	Katuna
FGD 2	Men	8	18 – 30	Mweso	Katuna
FGD 3	Men	8	60 +	Mweso	Katuna
FGD 4	Men	9	18 – 30	Mweso	Bweru
FGD 5	Men	10	60 +	Mweso	Bweru
FGD 6	Men	10	31 – 59	Mweso	Bweru
FGD 7	Women	10	31 – 59	Mweso	Kitshanga
FGD 8	Women	9	18 – 30	Mweso	Kitshanga
FGD 9	Women	9	31 – 50	Mweso	Kitshanga
FGD 10	Women	9	18 – 30	Mweso	Mokoto
FGD 11	Women	10	60 +	Mweso	Mokoto
FGD 12	Men	10	31 – 59	Mweso	Mokoto

Table 29: Characteristics of survey respondents, Mweso health zone, North Kivu, DRC (November 2021)

	Area		Age				Sex		Displacement status			Religion					Level of education			
	Rural	Urban	18 - 25	26 - 35	36 - 45	46 +	F	M	Res.	IDP in site	IDP in host family	Christian	Animism	Muslim	Other	Not want to respond	Primary	Secondary	University	None
Total	79%	21%	32%	30%	22%	16%	67%	33%	76%	12%	12%	99%	0%	0%	0%	0%	30%	23%	2%	46%
Age																				
18 to 25	78%	22%	----	----	----	----	75%	26%	72%	13%	15%	98%	1%	0%	1%	1%	32%	31%	2%	35%
26 to 35	79%	21%	----	----	----	----	66%	34%	75%	14%	12%	100%	----	----	0%	----	25%	26%	2%	46%
36 to 45	81%	19%	----	----	----	----	63%	37%	84%	7%	8%	100%	----	----	----	----	33%	15%	2%	50%
46 and over	79%	21%	----	----	----	----	59%	41%	78%	13%	12%	99%	----	1%	----	----	32%	12%	----	56%
Person at risk (over 55)																				
No	80%	20%	36%	35%	10%	19%	68%	32%	75%	13%	12%	99%	0%	----	0%	0%	30%	25%	2%	43%
Yes	74%	26%	---	---	100%	---	55%	45%	83%	6%	12%	99%	----	1%	----	----	30%	9%	----	60%
Sex																				
Women	75%	25%	32%	34%	19%	16%	---	---	74%	12%	14%	99%	----	0%	0%	---	39%	40%	1%	20%
Men	88%	12%	32%	23%	26%	18%	---	---	80%	12%	7%	99%	0%	----	---	1%	30%	25%	2%	43%
Health Area																				
Bibwe	100%	----	29%	23%	37%	12%	69%	31%	25%	50%	25%	100%	----	----	----	----	21%	12%	2%	65%
Bukama	100%	----	38%	28%	13%	22%	72%	28%	84%	----	16%	97%	----	----	----	3%	28%	22%	----	50%
Butale-Monokolo	100%	----	36%	38%	14%	13%	63%	38%	81%	11%	8%	100%	----	----	----	----	40%	26%	----	33%
Kamonyi	100%	----	29%	30%	26%	15%	54%	46%	87%	2%	10%	97%	----	1%	1%	1%	37%	20%	1%	43%
Katuna	100%	----	36%	22%	17%	25%	69%	31%	78%	10%	12%	100%	----	----	----	----	22%	37%	1%	39%
Kirumbu	100%	----	25%	39%	25%	11%	61%	39%	68%	18%	14%	98%	----	----	2%	----	25%	39%	----	36%
Kivuye	100%	----	22%	47%	13%	19%	59%	41%	78%	9%	13%	97%	3%	----	----	----	22%	13%	----	66%
Luhanga	100%	----	30%	26%	35%	9%	61%	39%	78%	13%	9%	100%	----	----	----	----	26%	22%	----	52%
Rugarama	32%	68%	32%	32%	21%	15%	78%	22%	82%	10%	8%	100%	----	----	----	----	30%	19%	3%	47%
St. Benoit	100%	----	33%	29%	22%	18%	33%	67%	79%	4%	17%	100%	----	----	----	----	50%	13%	----	38%
Displacement Status																				
Resident	77%	23%	31%	29%	22%	18%	65%	35%	100%	----	----	99%	0%	0%	0%	0%	30%	25%	2%	43%
IDP	85%	15%	34%	35%	20%	11%	73%	27%	----	51%	49%	99%	----	----	----	1%	29%	17%	----	54%
Area																				
Urban	----	----	31%	32%	22%	15%	80%	20%	82%	11%	7%	100%	----	0%	----	----	31%	23%	1%	46%
Rural	----	----	32%	30%	22%	18%	63%	37%	74%	13%	13%	99%	0%	----	0%	0%	28%	24%	5%	43%

Table 30: Surveyed population by profession, Mweso health zone, North Kivu, DRC (November 2021)

	Agriculture	Small business	Official/ employees	Daily paid agricultural work	Trade	Daily non-agricultural paid work	Small trades	Breeding/sale of livestock and products	Transport	Other	None
Total	74%	6%	4%	4%	2%	2%	1%	0%	0%	0%	5%
18 to 25	75%	8%	3%	5%	1%	1%	1%	----	----	----	7%
26 to 35	75%	5%	5%	3%	3%	2%	1%	0%	1%	0%	2%
36 to 45	76%	6%	6%	2%	2%	2%	3%	2%	----	----	3%
46 and over	69%	3%	5%	5%	3%	2%	1%	----	----	1%	10%
No	75%	6%	5%	4%	2%	2%	1%	1%	1%	0%	4%
Yes	65%	5%	3%	5%	2%	1%	1%	----	----	1%	16%
Women	76%	8%	2%	4%	3%	1%	1%	----	----	----	5%
Men	69%	2%	9%	4%	1%	2%	2%	1%	1%	1%	7%
Bibwe	67%	----		12%	2%	4%	2%	----	----	2%	12%
Bukama	66%	6%	16%	3%	----	3%	----	----	3%	----	3%
Butale-Monokolo	74%	6%	1%	8%	----	4%	1%	----	----	----	6%
Kamonyi	72%	----	7%	6%	----	3%	----	----	----	----	11%
Katuna	70%	7%	9%	1%	3%	----	3%	1%	----	----	6%
Kirumbu	89%	----	----	5%	2%	----	2%	----	----	----	2%
Kivuye	88%	3%	----	----	----	----	----	----	----	----	9%
Luhanga	87%	4%	----	----	4%	4%	----	----	----	----	----
Rugarama	73%	11%	4%	2%	3%	0%	1%	----	1%	0%	3%
St. Benoit	75%	4%	----	----	13%	----	----	8%	----	----	----
Resident	74%	6%	6%	3%	3%	2%	1%	0%	1%	0%	4%
IDP	75%	5%	1%	6%	----	2%	1%	1%	----	1%	9%
Rural	77%	3%	4%	4%	2%	2%	1%	1%	0%	0%	6%
Urban	64%	16%	7%	1%	4%	1%	2%	----	1%	----	4%

4.4.3 General knowledge about COVID-19

Quantitative results

Table 31-33 shows descriptive statistics about general knowledge of COVID-19. Almost all (99%) of respondents said that they have heard of COVID-19 (99%). In all subgroups at least half of respondents reported that everyone with COVID-19 has signs and symptoms. Most people (93%) reported that it is possible to take measures to reduce the risk of COVID-19 although that belief was lower in the older age group 46+ years (88%). The majority (78%) of respondents said that everyone had equal chance of becoming seriously ill from COVID-19 with only 11% saying that Older People (60+) were most likely to fall seriously ill. Only 9% of those 55 and over (at risk) report that older people are more likely to become seriously ill. There was no significant difference based on sex, displacement status or rural/urban. Respondents (72%) indicated that physical contact with infected person was how one contracted COVID-19 while 54% responded that other people sneezing/coughing was how to contract COVID-19. Older people were less well informed than younger. Table 34 shows factors associated with level of knowledge: primary and secondary levels of education are associated with higher odds of higher level of COVID-19 related knowledge compared to no education. Respondents from rural areas have lower odds to be well informed.

Qualitative results

All groups have heard of COVID-19, however all expressed that they had not yet seen or heard of COVID-19 cases in their village. Overall, the majority of FGD participants expressed that COVID-19 is a real disease (i.e., 74%, n=35), while a minority (26%, n=12) said that COVID-19 is an invented disease. Two groups expressed that COVID-19 is invented by power to make money. Another group expressed that it is a disease invented by whites to eliminate blacks. No specific dynamics were noticed among female and male FGDs. Regarding the impact of COVID-19 on daily life, all groups indicated that it has been significant. The majority of FGDs mentioned the closure of schools, and a minority of groups noted the closure of churches and markets. Also, the closing of the markets and the movement restrictions have had a negative impact on the daily life of the participants. Another trend that was noticed was the increase in the activities of armed groups, youth banditry, and police. One group (men) expressed that the police took advantage of the situation to intimidate the population, and another group (men) reported harassment and illegal tsubregions by armed groups.

Relevant Quotes:

“Community members think that this disease is a trick of the whites to eliminate the blacks because the disease did not appear here in Mokoto”

(female from Mokoto, age 18-30) (FGD 10)

Table 31: General knowledge of COVID-19 among the respondents to the household survey, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents who have heard of COVID-19			% of respondents saying that everyone with COVID-19 has signs and symptoms			% of respondents saying it is possible to take measures to reduce the risk of contracting COVID-19		
	Yes	No	Don't know/ don't want to answer	Yes	No	Don't know/ don't want to answer	Yes	No	Don't know/ don't want to answer
Total	99%	1%	0%	65%	11%	24%	93%	2%	5%
Age									
18 to 25	99%	1%	1%	66%	10%	25%	94%	3%	4%
26 to 35	99%	1%	----	64%	13%	22%	95%	1%	4%
36 to 45	100%	----	----	63%	11%	26%	93%	2%	6%
46 and over	99%	1%	----	69%	8%	24%	88%	5%	7%
Person at risk (over 55)									
No	99%	1%	0%	65%	11%	24%	94%	2%	4%
Yes	99%	1%	----	65%	9%	26%	86%	5%	9%
Sex									
Women	99%	1%	0%	64%	9%	26%	92%	3%	5%
Men	99%	1%	----	68%	13%	19%	94%	1%	5%
Health Area									
Bibwe	94%	4%	2%	58%	15%	27%	87%	8%	6%
Bukama	100%	----	----	63%	13%	25%	100%	----	----
Butale-Monokolo	100%	----	----	67%	11%	22%	89%	4%	7%
Kamonyi	99%	1%	----	62%	9%	29%	93%	5%	2%
Katuna	100%	----	----	71%	9%	20%	91%	2%	7%
Kirumbu	100%	----	----	66%	9%	25%	95%	2%	2%
Kivuye	100%	----	----	50%	16%	34%	88%	3%	9%
Luhanga	100%	----	----	65%	9%	26%	96%	----	4%
Rugarama	100%	0%	----	71%	9%	20%	96%	0%	3%
St. Benoit	96%	4%	----	50%	17%	33%	88%	----	13%
Displacement Status									
Resident	100%	0%	----	69%	12%	20%	93%	3%	4%
IDP	97%	2%	1%	55%	8%	37%	93%	3%	4%
Area									
Rural	99%	1%	0%	64%	11%	25%	93%	3%	5%
Urban	99%	1%	----	69%	10%	20%	94%	1%	5%

Table 32: Household survey respondents' belief about who becomes ill, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents indicating the groups most likely to become seriously ill from Covid-19								
	All	Older people (60+)	People with pre-existing conditions	Adults (19-59 years old)	Children (0-18 years old)	Pregnant or breastfeeding women	Health workers	Other	Don't know / don't want to answer
Total	78%	11%	0%	3%	2%	1%	0%	1%	6%
Age									
18 to 25	79%	10%	1%	2%	2%	2%	1%	2%	6%
26 to 35	80%	10%	0%	4%	1%	1%	0%	0%	4%
36 to 45	76%	15	0%	4%	5%	1%	0%	0%	4%
46 and over	76%	10%	0%	1%	0%	1%	0%	2%	10%
Person at risk (over 55)									
No	78	11%	0%	3%	2%	1%	0%	1%	5%
Yes	77%	9%	0%	0%	0%	1%	0%	0%	14%
Sex									
Women	78%	11%	0%	3%	2%	1%	0%	1%	6%
Men	79%	12%	0%	3%	2%	2%	0%	1%	5%
Health Area									
Bibwe	77%	6%	0%	0%	2%	0%	0%	2%	13%
Bukama	84%	6%	0%	6%	3%	0%	0%	0%	0%
Butale-Monokolo	69%	15%	0%	3%	6%	1%	0%	0%	8%
Kamonyi	77%	13%	0%	5%	1%	1%	0%	1%	5%
Katuna	75%	15%	0%	3%	0%	1%	0%	3%	6%
Kirumbu	82%	9%	0%	2%	0%	2%	2%	0%	7%
Kivuye	78%	6%	0%	0%	3%	0%	0%	0%	13%
Luhanga	74%	4%	0%	4%	0%	9%	0%	0%	13%
Rugarama	81%	11%	0%	2%	1%	1%	0%	1%	3%
St. Benoit	92%	8%	0%	0%	4%	0%	0%	0%	0%
Displacement Status									
Resident	81%	10%	0%	3%	1%	1%	0%	1%	5%
IDP	71%	15%	0%	2%	4%	1%	0%	1%	8%
Area									
Rural	78%	10%	0%	3%	2%	1%	0%	1%	7%
Urban	79%	13%	1%	2%	0%	2%	1%	2%	4%

Table 33: Household survey respondents' understanding of how to contract COVID-19, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents by means of contracting COVID-19								
	Through physical contact with infected people	Via particles in the air	Through physical contact with a contaminated object /surface	By eating certain foods	By washing in contaminated water	By drinking contaminated water	Contaminated breast milk / breastfeeding	Other	Don't know / don't want to answer
Total	72%	53%	39%	4%	3%	2%	1%	0%	7%
Age									
18 to 25	72%	49%	39%	3%	3%	3%	1%	0%	8%
26 to 35	75%	56%	39%	4%	5%	2%	0%	0%	3%
36 to 45	74%	56%	42%	4%	2%	1%	1%	0%	5%
46 and over	66%	53%	37%	3%	3%	2%	2%	0%	11%
Person at risk (over 55)									
No	74%	53%	40%	4%	3%	2%	1%	0%	5%
Yes	57%	53%	35%	3%	3%	2%	0%	0%	15%
Sex									
Women	71%	53%	39%	3%	3%	2%	1%	0%	7%
Men	74%	54%	39%	5%	4%	3%	1%	0%	5%
Health Area									
Bibwe	75%	54%	35%	6%	6%	0%	0%	0%	15%
Bukama	81%	56%	34%	3%	3%	3%	0%	0%	3%
Butale-Monokolo	72%	40%	40%	1%	6%	1%	1%	0%	8%
Kamonyi	63%	41%	36%	3%	5%	5%	1%	0%	7%
Katuna	65%	55%	45%	7%	6%	3%	1%	0%	7%
Kirumbu	73%	61%	43%	2%	0%	0%	0%	0%	2%
Kivuye	56%	41%	25%	9%	3%	6%	3%	0%	13%
Luhanga	87%	57%	43%	4%	4%	0%	4%	0%	4%
Rugarama	78%	61%	40%	1%	1%	1%	0%	0%	4%
St. Benoit	63%	54%	42%	4%	0%	4%	0%	0%	4%
Displacement Status									
Resident	73%	55%	40%	4%	3%	2%	1%	0%	6%
IDP	68%	46%	35%	3%	3%	1%	1%	0%	8%
Area									
Rural	70%	50%	37%	4%	4%	3%	1%	0%	7%
Urban	79%	66%	47%	1%	1%	0%	1%	0%	6%

Table 34: Factors associated with general knowledge related to COVID-19 in Mweso health zone, 2021.

N = 655	Odds ratio	Confidence Interval	p Value
Sex (ref male)			
Female	1.02448	.6814141 - 1.540266	0.907
Age (ref 18-29)			
30-59	1.253515	.8568385 - 1.833833	0.244
60+	1.148642	.6076756 - 2.171191	0.670
Setting (ref urban)			
Rural	**.63868**	**.4176643 .9766507**	**0.039**
Displacement Status (ref residents)			
Displaced	.7750467	.5069764 - 1.184863	0.239
Education (ref none)			
Primary	**1.670684**	**1.094154 - 2.551**	**0.017**
Secondary	**2.031581**	**1.234976 - 3.342025**	**0.005**
University	1.066583	.2348156 4.844648	0.933
Profession (ref none)			
Agriculture	.736495	.3456527 - 1.569277	0.428
Trade	.5712955	.2168024 1.505419	0.257
Public Official	.6736643	.218664 2.075438	0.491
Other	1.380342	.4632277 - 4.11319	0.563

Note: Bold results are statistically significant at 0.005 level.

4.4.4 Knowledge and reported practice of preventative measures

Quantitative results

Table 35 shows descriptive statistics about knowledge of preventative measures against contracting COVID-19 and table 36 shows reported practice.

Wearing a mask was the most common means (91%) to reduce the risk of contracting COVID-19. Washing one's hands (79%), stop shaking hands or kissing (56%), reducing contact with others (45%) and physical distancing (36%) were also understood to reduce the risk. 10% of those at risk (55+ years) say praying is a means of reducing the risk of contracting COVID-19.

Only about half (58%) of the respondents wore a mask with slightly more men (61%) than women (57%) practicing this. In every subgroup, more people responded they are not maintaining physical distance from others when in public. Less than half (44%) of the people maintain physical distance. The difference was within 10% for all subgroups except for displaced people where 39% say they are maintaining physical distance while 61% say they are not. The majority of respondents (70%) indicated that they wash their hands with soap and water after being in a busy public place. Less women than men practiced this, less urban people than rural, and one third of persons at risk (55+ years) did not practice this.

Education was associated with higher odds of reporting wearing a mask and washing hands (table 37). Female sex was associated with lower odds of reporting hand washing.

Qualitative results

FGD participants said people have indeed changed their behavior by following the restrictions, sometimes to avoid COVID-19, sometimes to avoid law enforcement and fines. The measures most adopted were wearing a mask, washing hands, and avoiding hand shaking. Over time, the communities report a decrease in the rigor in the application of preventative measures. As no case was detected in the communities, and because the state no longer insists, a relaxation is noted in the adoption of measures. Today people report washing their hands regularly and wearing masks regularly however frequency has decreased. There was still a reported lack of soap and availability of masks as well as financial barriers in accessing them. These measures were said to be imposed and not adopted so people were more afraid then worried about their own protection. Social distancing is not respected, and people continue to socialize as before. Washing hands is common after the toilet, before eating, after changing diapers and this measure is said to be the most applied because it protects against several other disease such as diarrhea and cholera but not because of COVID-19.

Relevant Quotes

"We favored to buy food for children than nose masks". (female from, Mweso Village aged 31 to 59) (FGD 1)

Table 35: Knowledge about COVID-19 preventive measures among respondents to the household survey, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents who reported ways to reduce the risk of contracting COVID-19									
	Wear a mask	Wash one's hands	Stop shaking hands or kissing	Reduce contact with others	Increase the physical distance between yourself and others	Wearing gloves	Disinfect and/or clean objects and surfaces	Pray	Other	Don't know / don't want to answer
Total	91%	79%	56%	45%	36%	9%	8%	4%	0%	0%
Age										
18 to 25	89%	74%	51%	46%	33%	11%	3%	2%	0%	0%
26 to 35	95%	76%	57%	47%	41%	112%	11%	2%	1%	1%
36 to 45	94%	83%	61%	41%	36%	7%	9%	6%	0%	0%
46 and over	88%	86%	59%	44%	30%	4%	8%	10%	1%	1%
Person at risk (over 55)										
No	92%	78%	56%	46%	36%	9%	8%	4%	0%	0%
Yes	82%	85%	58%	42%	31%	7%	7%	8%	1%	0%
Sex										
Women	90%	78%	53%	42%	32%	9%	8%	4%	0%	0%
Men	91%	80%	61%	51%	42%	9%	7%	4%	0%	0%
Health Area										
Bibwe	84%	71%	51%	40%	44%	18%	9%	4%	0%	0%
Bukama	84%	88%	47%	53%	34%	0%	3%	3%	0%	0%
Butale-Monokolo	89%	67%	61%	59%	52%	16%	9%	6%	2%	0%
Kamonyi	91%	73%	49%	46%	27%	10%	4%	0%	0%	2%
Katuna	90%	86%	67%	48%	33%	10%	6%	5%	0%	0%
Kirumbu	90%	83%	52%	50%	31%	7%	5%	7%	0%	0%
Kivuye	96%	61%	50%	36%	29%	7%	0%	4%	0%	0%
Luhanga	86%	77%	50%	41%	18%	0%	5%	5%	0%	0%
Rugarama	93%	84%	58%	43%	39%	8%	12%	4%	1%	0%
St. Benoit	90%	71%	57%	19%	19%	0%	0%	5%	0%	0%
Displacement Status										
Resident	91%	81%	58%	46%	36%	11%	9%	4%	0%	0%
IDP	90%	71%	49%	43%	35%	3%	3%	3%	0%	1%
Area										
Rural	90%	76%	54%	48%	34%	9%	6%	4%	0%	0%
Urban	95%	88%	62%	36%	40%	11%	14%	4%	1%	0%

Table 36: Reported practice of preventive measures among respondents to the household survey, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents reporting to wear masks, for example inside public buildings, or in shops or markets			% of respondents reporting maintaining physical distance from other people when in public			% of respondents reporting washing their hands with soap and water for at least 20 seconds after being in busy public places		
	Yes	No	Do not wish to respond	Yes	No	Do not wish to respond	Yes	No	Do not wish to respond
Total	58%	42%	----	44%	54%	1%	70%	28%	2%
Age									
18 to 25	55%	45%	----	46%	54%	1%	69%	29%	2%
26 to 35	58%	42%	----	43%	57%	0%	71%	28%	1%
36 to 45	68%	32%	----	45%	52%	3%	80%	19%	2%
46 and over	56%	44%	----	44%	54%	2%	62%	34%	5%
Person at risk (over 55)									
No	58%	42%	----	44%	55%	1%	71%	27%	2%
Yes	58%	43%	----	59%	49%	2%	62%	34%	5%
Sex									
Women	57%	43%	----	42%	57%	1%	66%	32%	2%
Men	61%	39%	----	49%	50%	1%	78%	21%	2%
Health Area									
Bibwe	48%	52%	----	37%	62%	2%	54%	37%	10%
Bukama	66%	34%	----	50%	50%	----	66%	31%	3%
Butale-Monokolo	54%	46%	----	56%	44%	----	67%	33%	----
Kamonyi	53%	47%	----	36%	62%	2%	64%	31%	5%
Katuna	66%	34%	----	46%	52%	2%	78%	22%	----
Kirumbu	55%	45%	----	39%	59%	2%	80%	20%	----
Kivuye	75%	43%	----	47%	50%	3%	75%	22%	3%
Luhanga	57%	43%	----	35%	65%	----	78%	22%	----
Rugarama	58%	42%	----	47%	52%	0%	70%	29%	1%
St. Benoit	58%	42%	----	42%	58%	----	75%	21%	4%
Displacement Status									
Resident	61%	39%	----	46%	52%	2%	71%	26%	3%
IDP	51%	49%	----	39%	61%	----	66%	34%	1%
Area									
Rural	59%	41%	----	44%	54%	2%	72%	26%	3%
Urban	56%	44%	----	46%	54%	----	62%	38%	----

Table 37: Factors associated with reported practice of preventative measures (wearing a mask, physical distancing, hand washing), Mweso health zone, DRC, November 2021

	Wearing a mask			Physical distancing			Hand washing		
N = 655	**Odds ratio**	**Confidence Interval**	**p Value**	**Odds ratio**	**Confidence Interval**	**p Value**	**Odds ratio**	**Confidence Interval**	**p Value**
Sex (ref male)									
Female	1.005253	.6842737 - 1.476799	0.979	.8510523	.5815168 - 1.245519	0.407	.6520257	.4195214 - 1.013387	0.057
Age (ref 18-29)									
30-59	1.037704	.7309529 - 1.473187	0.836	.8465046	.5977782 - 1.198722	0.348	1.001632	.679867 - 1.475682	0.993
60+	.8011456	.4477137 - 1.433582	0.455	1.214237	.6765085 - 2.155881	0.523	.5707141	.3045614 - 1.069454	0.080
Setting (ref urban)									
Rural	1.112071	.7348801 - 1.682863	0.615	.9406184	.6232266 - 1.419649	0.771	1.546938	.9956331 - 2.403514	0.052
Displacement Status (ref residents)									
Displaced	.6968545	.4775596 - 1.016849	0.061	.8717185	.5943704 - 1.278484	0.482	.883235	.5848207 - 1.33392	0.555
Education (ref none)									
Primary	1.107389	.7481193 - 1.639191	0.610	1.213912	.8220589 - 1.79255	0.330	**1.60948**	**1.037807 - 2.496056**	**0.034**
Secondary	1.107449	.6918313 - 1.772748	0.671	1.252128	.7855561 - 1.995814	0.345	1.053079	.6293697 - 1.762042	0.844
University	1.023523	.2236592 - 4.68391	0.976	2.453189	.5507986 - 10.9262	0.239	.99587	.1621674 - 6.115637	0.996
Profession (ref none)									
Agriculture	.7966469	.3878343 - 1.636385	0.536	.7808548	.3841471 - 1.587242	0.494	.5820974	.2485482 - 1.363266	0.213
Trade	.7502895	.3033243 - 1.855883	0.534	.8533615	.3485347 - 2.089392	0.729	.5893248	.2485482 - 1.363266	0.315
Public Official	1.621236	.4999658 - 5.257172	0.421	1.068654	.3558416 - 3.209352	0.906	3.402432	.575873 - 20.1026	0.177
Other	1.881419	.5861137 - 6.039334	0.288	1.662745	.5626 - 4.914185	0.358	.4984691	.1443781 - 1.720977	0.271
Knowledge of Covid (ref none)									
Partially informed	**1.809401**	**1.053348 - 3.108119**	**0.032**	**2.026484**	**1.132165 - 3.627245**	**0.017**	**2.077447**	**1.193685 - 3.615515**	**0.010**
Informed	1.43166	.7988675 - 2.565697	0.228	**1.787407**	**.9594987 - 3.32968**	**0.067**	**3.595918**	**1.919918 - 6.734992**	**0.000**
Well informed	.2522375	.0218175 - 2.916183	0.270	1	-	-	.1580045	.0110167 - 2.266151	0.174

Note: results in bold are statistically significant at 0.005 level.

4.4.5 Information sources

Quantitative results

The most common source of information about COVID-19 was from the radio (overall 44%) although this was less common in the subgroup of people 46+ years (table 38). They relied more on their circle of friends or relatives, and community/religious leaders as did women. NGOs (1%) and health workers going door to door (5%) were amongst the least common sources of information. There was quite a lot of variation depending on the geographic area. Radio ranged from 25% in Bukama to 66% in Kivuye; health care workers as a source ranged from 6% in Kivuye to 31% in Bukama.

The most trusted source of information overall was the radio (50%) (table 39). Information via health workers in health facilities (18%) and from family/friends (16%) were the next most reliable source. Persons at risk (over 55+ years) trusted the radio less and consider community/religious leaders as trusted sources. People in rural areas depended slightly more on information from health facilities than their urban counterparts (19% versus 12%) and relied on the radio less.

Qualitative results

Radio, health providers, and community health workers (in order of frequency) were the most frequently mentioned sources of information. Other sources mentioned were word of mouth, social media, merchants in Goma, bikers, the police, and other health personnel such as nurses. Most groups trusted the sources of information. A minority said they did not trust radio as radio "mystifies things" (FGD male). All groups except one expressed facing obstacles in accessing reliable information on the pandemic and on preventative measures. The obstacles mentioned most often were poverty, lack of resources to buy a radio or telephone (8 out of 12 groups). Then, a minority of the groups spoke of the condition of the roads as an obstacle to obtaining reliable information. Another obstacle mentioned by a few groups was the lack of training on COVID-19 among the community health workers. One group of older men said that there were no obstacles accessing reliable information on the pandemic as organizations like ACF (Action Contre la Faim) and UNICEF informed them about the pandemic.

As for rumors to prevent COVID-19, many FGD participants had not heard any, and tended to list generally accepted measures, such as washing hands, wearing a mask, etc. A number of different rumors were heard by most FGDs about how to fight COVID-19. Rumors included drinking local and strong alcoholic beverages (i.e., rutuku), consulting traditional practitioners, and putting a hair in the water and drink this water. Another group had heard a rumor that the COVID-19 vaccine kills the elderly, and another group said they had heard about staying near trees to protect against COVID-19. The same group who did not face barriers in accessing information confirmed they were well informed by ACF on how to fight against COVID-19. None of the groups reported implementing any of the rumors. In fact, half of the groups reported implementing preventative measures, while the other half of the groups did not comply with preventative measures as they had not seen any cases of COVID-19 in their villages.

Relevant Quotes:

"We use the information we receive from health providers and community relays who are knowledgeable to seek advice for our family members" (male from Bweru village, over 60 years old) (FGD 5)

Table 38: Sources of information reported by the respondents to the household survey, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents by source of information regarding COVID-19								
	Radio	Entourage (family and friends)	Health workers in health facilities	Community or religious leader	Healthcare workers going door to door	Social networks or messaging applications	NGOs	Other	Don't know / don't want to answer
Total	44%	26%	15%	6%	5%	2%	1%	0%	0%
Age									
18 to 25	53%	22%	13%	7%	3%	2%	1%	----	1%
26 to 35	44%	25%	18%	5%	5%	1%	1%	----	----
36 to 45	44%	27%	15%	6%	4%	5%	1%	----	----
46 and over	32%	32%	16%	9%	7%	----	3%	1%	----
Person at risk (over 55)									
No	47%	24%	16%	6%	4%	2%	1%	----	0%
Yes	27%	37%	13%	12%	7%	----	3%	1%	----
Sex									
Women	41%	29%	16%	7%	5%	0%	1%	0%	0%
Men	50%	20%	14%	5%	5%	4%	2%	----	----
Health Area									
Bibwe	33%	40%	19%	4%	2%	----	2%	----	----
Bukama	25%	19%	31%	6%	9%	----	6%	----	3%
Butale-Monokolo	50%	19%	11%	6%	10%	3%	1%	----	----
Kamonyi	36%	37%	16%	6%	3%	2%	----	----	----
Katuna	47%	24%	11%	9%	3%	2%	3%	----	----
Kirumbu	52%	20%	11%	11%	2%	2%	----	----	----
Kivuye	66%	19%	6%	6%	----	3%	----	----	----
Luhanga	26%	35%	17%	9%	4%	4%	----	4%	----
Rugarama	48%	22%	18%	5%	5%	1%	1%	----	----
St. Benoit	42%	38%	8%	8%	4%	----	----	----	----
Displacement Status									
Resident	44%	26%	16%	5%	5%	2%	1%	0%	0%
IDP	44%	27%	12%	10%	5%	----	1%	----	----
Area									
Rural	42%	26%	17%	6%	5%	2%	2%	0%	0%
Urban	51%	26%	11%	7%	4%	1%	1%	----	----

Table 39: Most trusted sources of information reported by the respondents to the household survey, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents by source of information considered the most reliable for obtaining COVID-19 information								
	Radio	Health workers in health facilities	Entourage (family and friends)	Community or religious leader	Healthcare workers going door to door	Other	NGOs	Social networks or messaging applications	Don't know / don't want to answer
Total	50%	18%	16%	5%	5%	2%	2%	1%	0%
Age									
18 to 25	59%	15%	15%	4%	3%	1%	1%	2%	1%
26 to 35	47%	21%	16	5%	6%	3%	1%	1%	----
36 to 45	52%	13	18	5%	7%	2%	3%	1%	----
46 and over	43%	20%	18	9%	6%	1%	3%	----	----
Person at risk (over 55)									
No	52%	18%	16%	4%	5%	2%	2%	1%	0%
Yes	41%	17%	20	13%	7%	1%	1%	----	----
Sex									
Women	49%	19%	17%	6%	4%	3%	1%	1%	0%
Men	53%	15%	15%	5%	8%	----	2%	2%	----
Health Area									
Bibwe	44%	17%	21%	6%	4%	4%	2%	2%	----
Bukama	44%	31%	6%	3%	9%	3%	3%	----	----
Butale-Monokolo	46%	13%	14%	6%	17%	----	3%	3%	----
Kamonyi	47%	21%	23%	6%	1%	1%	----	1%	----
Katuna	54%	13%	16%	9%	3%	3%	1%	----	----
Kirumbu	59%	16%	7%	9%	5%	----	2%	----	2%
Kivuye	66%	9%	16%	6%	----	3%	----	----	----
Luhanga	26%	26%	26%	9%	9%	----	4%	----	----
Rugarama	52%	19%	15%	3%	5%	1%	2%	2%	0%
St. Benoit	54%	13%	29%	4%	----	----	----	----	----
Displacement Status									
Resident	49%	19%	17%	5%	5%	1%	2%	1%	----
IDP	53%	12%	16%	6%	6%	4%	1%	1%	1%
Area									
Rural	49%	19%	16%	6%	5%	2%	2%	1%	0%
Urban	55%	12%	17%	3%	6%	2%	1%	3%	1%

4.4.6 Vaccination

Quantitative results: willingness to be vaccinated

Table 40 shows results related to the willingness of the respondents to be vaccinated. Half (50%) of the respondents indicated that they would be willing to get vaccinated while about a fifth said they were either "very probably" willing to get vaccinated (17%) or "certainly not" (21%). This shows a real spread of interest in the vaccine in the respondents. The elderly and those at risk responded the same as the general population. Men were more willing to get vaccinated than women (56% versus 47%). Rural populations were more willing to get vaccinated than urban populations with 20% very likely versus 8% of the urban population. There is geographic variation. Respondents from rural areas were more likely to be willing to be vaccinated, while the highest level of education (University) was associated with lower odds of getting vaccinated (statistically significant at 0.05 level). Being displaced was associated with higher odds of getting vaccinated (although just above 0.05 significance level) (table 41).

Qualitative results: attitude towards vaccination

Half of the groups report fears about the COVID-19 vaccine while all groups have confidence in the other vaccines (those given to children). Nevertheless, the groups heard about the rumors about the effect of the COVID-19 vaccine. The most heard rumor was that the vaccine can kill people. Other rumors were that the vaccine could control the body, that the vaccine is satanic, can disable, or can cause the body to bloat. A minority of the groups think that the vaccine kills or does not work well because it is the first vaccine and are therefore not sure if they will take the vaccine as soon as it is available. They want more information about this new vaccine, and the side effects, before making a decision.

Relevant Quotes:

"Vaccines protect us from diseases like measles, tuberculosis, etc. but we don't like the COVID-19 vaccine because of the rumors that are out there and because it is the first vaccine."

(female from Kishanga village, age 18-30) (FGD 8)

"If there is a vaccine, before taking it, we would like to be told its importance and side effects"

(male from Katuna village, age 60+) (FGD 3)

Table 40: Willingness to get vaccinated against COVID-19, Mweso health zone, North Kivu, DRC (November 2021)

	Willingness to get vaccinated				
	Very Probably	Probably	Uncertain	Probably Not	Certainly Not
Total	17%	33%	16%	12%	21%
Age					
18 to 25	19%	29%	16%	13%	23%
26 to 35	17%	39%	14%	10%	20%
36 to 45	17%	28%	21%	10%	24%
46 and over	15%	35%	17%	14%	19%
Person at risk (over 55)					
No	18%	33%	16%	11%	21%
Yes	13%	34%	19%	13%	22%
Sex					
Women	15%	32%	17%	12%	24%
Men	21%	35%	16%	11%	17%
Health Area					
Bibwe	22%	38%	13%	6%	19%
Bukama	13%	28%	31%	19%	9%
Butale-Monokolo	14%	49%	7%	8%	22%
Kamonyi	22%	44%	11%	6%	17%
Katuna	18%	29%	13%	19%	20%
Kirumbu	25%	34%	16%	7%	18%
Kivuye	28%	19%	13%	13%	28%
Luhanga	9%	26%	39%	9%	17%
Rugarama	14%	28%	17%	13%	27%
St. Benoit	8%	29%	38%	13%	13%
Displacement Status					
Resident	14%	34%	17%	14%	21%
IDP	27%	32%	13%	5%	22%
Area					
Urban	8%	26%	19%	16%	31%
Rural	20%	35%	16%	10%	19%

Table 41: Factors associated with willingness to be vaccinated against COVID-19, Mweso health zone, November 2021

N = 547	Odds ratio	Confidence Interval	p Value
Sex (ref male)			
Female	.7340079	.4708709 - 1.144194	0.172
Age (ref 18-29)			
30-59	1.136127	.7638068 - 1.689935	0.529
60+	.817948	.4159484 - 1.608466	0.560
Setting (ref urban)			
Rural	**2.26032**	**1.416058 - 3.607936**	**0.001**
Displacement Status (ref residents)			
Displaced	1.523704	.9845747 - 2.358047	0.059
Education (ref none)			
Primary	1.039224	.6654624 - 1.622911	0.866
Secondary	.8878045	.5208973 - 1.513152	0.662
University	**.098049**	**.0102162 - .9410137**	**0.044**
Profession (ref none)			

Agriculture	.9258836	.3858653 - 2.221657	0.863
Trade	.6351941	.2137787 - 1.887333	0.414
Public Official	1.533556	.3947412 - 5.957809	0.537
Other	.7588913	.205133 - 2.807525	0.679
Knowledge of Covid (ref none)			
Partially informed	.9153994	.5108187 - 1.640418	0.766
Informed	1.84173	.9567821 - 3.545185	0.068
Well informed	1.123461	.1302783 - 9.688226	0.916

Note: Bold results are statistically significant at 0.005 level.

4.4.7 Health care seeking behavior

Quantitative results

Tables 42 to 48 detail health seeking behaviors of the population of interest in general (table 42), one month before data collection (tables 43-45) and during the first months of COVID-19 restrictions (March to May 2020) (tables 46-48).

In general

Almost all (91%) the respondents said they would probably or very probably consult a doctor or nurse if they are sick or in bad shape (table 42). Respondents who are 18 to 25 responded an even split between those who responded most likely, very probably, and uncertain (33% each). All older respondents would seek care. There was a variation in responses depending on geographic areas; one fifth of the internally displaced reported being uncertain whether they would consult a doctor as opposed to the residents (0%). All urban respondents would very probably seek care, while there was more uncertainty among rural respondents. With regard to seeking medicines at a pharmacy, it is an even split between those who responded very probably and those who responded probably.

With regard to cases of illness in the 30 days before the survey

One third (32%) of respondents claimed a family member had been sick while another fifth (19%) reported that they themselves had been sick. Rates of sickness were higher for people over 46 years (26%) and persons at risk (28%). Most respondents reported seeking treatment or advice (94%). Less men than women sought care, the displaced did not seek care as much as the resident and there was some geographical variation. The most common symptom was fever (63%), chronic headaches (38%) and cough (24%). Urban residents had not chronic headaches while rural areas had more breathing difficulties (table 43). Financial reasons were the most common reason (81%) for not seeking treatment. Certain sub-groups had 100% responding that finances were the biggest barrier: 18 to 25, 46 and over, persons at risk. Many of the regions (6 out of 10) responded that finance was the only reason. Access, security and trust did not seem to be an issue (table 44). More than half (63%) of all the respondents chose health centers for treatment followed by hospital and pharmacy. Hospitals were used by more respondents in urban than in rural areas; by more IDP than residents. There was a geographic disparity in seeking care with some regions using health centers much more than hospitals (table 45).

Changes in health care seeking behavior in the first months of COVID-19

Tables 46 to 48 describe the health seeking behaviors of the population of interest in the first months after the outbreak of COVID-19 (end of March to end of May 2020). Most respondents did not report having an illness event during the first months of COVID-19 restrictions (76%). The most common symptoms were a fever (71%) followed by cough (31%) and chronic headaches (26%). Persons at risk had less acute diarrhea and difficulty breathing but more chronic headaches. There were geographic variations. Almost all respondents sought assistance when they felt sick (97%) with no variations between genders, rural – urban or displaced – resident respondents. Persons at risk sought care less frequently than persons not at risk (87% versus 98%). Patients who experienced symptoms most often sought care at the health center (67%). Traditional healers, mobile clinics, and private doctors were uncommon responses. Hospital, pharmacy, and health post represent 20%, 17%, and 12% of respondents respectively. Displaced persons compared to residents sought care more frequently from traditional healers (5% versus 0%) and visited health centers and pharmacies less frequently.

Most respondents (79%) said their children were brought to routine vaccination during the first months of COVID-19. A slightly higher proportion of displaced persons (compared to residents) and rural populations (compared to urban) reported vaccinated their children. 22% of respondents said that the reason for not having their children vaccinated was because vaccinated services were not offered, or the household was worried about COVID-19 infection (21%). Despite those being the common responses marked, the most common response in every subgroup was “other” indicating another reason for not having their child vaccinated. Worry about COVID-19 infection was more common in men than women (34% versus 16%) and amongst urban populations (28% versus 5%). Interruption of services was mentioned as a reason by 41% of the urban vs 15% of the rural respondents. Vaccination campaigns were not interrupted.

Qualitative results

All groups report that people turn to health centers when seeking care. They always visit the same institute for care and this decision is made in the family, according to all groups. There was just one participant who said that there are still people who go to traditional healers. The symptoms that lead households to consult a health provider immediately are fever because associated with a risk of malaria, cough, fatigue, diarrhea, tiredness and vomiting. Access to care is said to be difficult because of the associated financial burden. The lack of structure and medicines are also barriers to access to care, which is very unequal in the study area. Trust in health providers is based on a lack of diversified solutions, these structures are their only solution to seek treatment or access a diagnosis, according to the focus groups.

Changes in behavior

In terms of change in care-seeking behavior, all groups said they continued to visit health care providers as they did before the pandemic. They said they always visited the health center. Groups complained about the cost of visiting the health center for people over 5 years old with lack of money to pay for care cited as the most common barrier to seeking treatment.

Relevant Quotes: *“We have difficulties [accessing health care] for financial reasons, because if the illness is serious there must be a transfer to Mweso [the city].” (female from Mokoto village, age 60+) (FGD 11)*

Table 42: General availability of health care providers and likelihood to seek care and medicines, Mweso health zone, DRC, Nov 2021

	In general, which health care providers are physically accessible to you and your household members?					If you were sick, how likely it is you would look for advice from a doctor or nurse?			How likely it is you would seek medicines from a pharmacy or clinic?	
	Health center	Hospital	Health Post	Pharmacy	Traditional healer	Probably	Very probable	Uncertain	Very probable	Probable
Total	73%	32%	18%	9%	0%	50%	41%	9%	50%	50%
Respondent age										
18 to 25	83%	33%	0%	0%	0%	33%	33%	33%	50%	50%
26 to 35	78%	33%	22%	11%	0%	67%	33%	----	33%	67%
36 to 45	50%	25%	50%	25%	0%	25%	75%	----	100%	----
46 +	67%	33%	0%	0%	0%	67%	33%	----	33%	67%
Person at risk (55+)										
Non	75%	30%	20%	10%	0%	50%	40%	10%	50%	50%
Yes	50%	50%	0%	0%	0%	50%	50%	----	50%	50%
Respondent sex										
Women	100%	25%	0%	0%	0%	50%	38%	13%	50%	50%
Men	57%	36%	29%	14%	0%	50%	43%	7%	50%	50%
Health area										
Bibwe	100%	50%	0%	0%	0%	100%	----	----	----	100%
Bukama	100%	0%	0%	0%	0%	100%	----	----	----	100%
Butale-Monkolo	0%	0%	50%	50%	0%	100%	----	----	----	100%
Kamonyi	100%	50%	33%	0%	0%	33%	67%	----	67%	33%
Katuna	60%	0%	20%	20%	0%	40%	40%	20%	80%	20%
Kirumbu	50%	50%	0%	0%	0%	50%	----	50%	----	100%
Kivuye	50%	50%	0%	0%	0%	----	100%	----	100%	----
Luhanga	----	----	----	----	----	----	----	----	----	----
Rugarama	100%	100%	0%	0%	0%	----	100%	----	100%	----
St Benoit	100%	0%	0%	0%	0%	100%	----	----	----	100%
Displacement status										
Resident	77%	31%	31%	8%	0%	54%	46%	----	54%	46%
IDP	67%	33%	0%	11%	0%	44%	33%	22%	44%	56%
Setting										
Rural	71%	29%	19%	10%	0%	52%	38%	10%	48%	52%
Urban	100%	100%	0%	0%	0%	----	100%	----	100%	----

Table 43: Proportion of households with illness events in the 30 days before the survey, health care seeking behavior and symptoms, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents with a household member who has been ill in the last 30 days			% of patients seeking advice or treatment	% of sick people by reported symptom (multiple choice)						
	No	Yes- family member	Yes – myself		Fever	Chronic headaches	Cough	Itching scabies	Acute diarrhea	Breathing difficulty	Other
Total	49%	32%	19%	94%	63%	38%	24%	0%	12%	8%	21%
Age											
18 to 25	51%	32%	17%	95%	60%	33%	21%	0%	16%	11%	16%
26 to 35	52%	34%	14%	91%	66%	34%	22%	0%	15%	7%	25%
36 to 45	44%	34%	21%	93%	65%	40%	18%	0%	12%	8%	22%
46 and over	45%	29%	26%	96%	60%	45%	33%	0%	5%	6%	21%
Person at risk (over 55)											
No	50%	33%	18%	93%	65%	37%	22%	0%	13%	9%	20%
Yes	47%	28%	26%	96%	50%	39%	33%	0%	7%	7%	26%
Sex											
Women	53%	29%	18%	97%	63%	40%	25%	0%	14%	9%	21%
Men	41%	39%	20%	89%	62%	34%	21%	0%	10%	7%	21%
Health Area											
Bibwe	54%	23%	23%	92%	67%	33%	29%	0%	13%	13%	21%
Bukama	47%	34%	19%	94%	59%	47%	12%	0%	18%	0%	18%
Butale-Monokolo	44%	39%	15%	95%	67%	28%	26%	0%	26%	5%	10%
Kamonyi	45%	30%	25%	88%	65%	42%	25%	0%	10%	10%	23%
Katuna	49%	35%	16%	89%	64%	49%	29%	0%	13%	9%	20%
Kirumbu	50%	30%	20%	91%	50%	45%	18%	0%	5%	0%	27%
Kivuye	66%	16%	19%	82%	45%	45%	18%	0%	0%	9%	18%
Luhanga	43%	35%	22%	100%	54%	23%	23%	0%	0%	8%	38%
Rugarama	47%	37%	16%	100%	66%	34%	24%	0%	11%	11%	21%
St. Benoit	75%	8%	17%	83%	50%	17%	0%	0%	17%	0%	17%
Displacement Status											
Resident	49%	32%	18%	95%	63%	37%	26%	0%	12%	9%	20%
IDP	50%	31%	19%	89%	63%	41%	18%	0%	13%	5%	23%
Setting											
Rural	48%	32%	20%	92%	64%	41%	22%	0%	12%	7%	21%
Urban	54%	33%	13%	100%	57%	24%	30%	0%	14%	16%	21%

Table 44: Respondents reasons for not seeking care following an illness event in the 30 days before the survey, Mweso health zone, North Kivu, DRC (November 2021)

	% of patients by reason not seeking advice or treatment							
	Financial reasons (too expensive treatment)	The illness was not serious/could be treated at home	Does not trust health service providers	Did not know how to access treatment	Security reasons (too dangerous access)	Health service providers are too far away to access	Other	Don't know / don't want to answer
Total	81%	10%	5%	5%	0%	0%	5%	0%
Age								
18 to 25	100%	0%	0%	0%	0%	0%	0%	0%
26 to 35	78%	11%	0%	11%	0%	0%	0%	0%
36 to 45	50%	25%	25%	0%	0%	0%	25%	0%
46 and over	100%	0%	0%	0%	0%	0%	0%	0%
Person at risk (over 55)								
No	79%	11%	5%	5%	0%	0%	5%	0%
Yes	100%	0%	0%	0%	0%	0%	0%	0%
Sex								
Women	86%	14%	0%	0%	0%	0%	0%	0%
Men	79%	7%	7%	7%	0%	0%	7%	0%
Health Area								
Bibwe	100%	0%	0%	0%	0%	0%	0%	0%
Bukama	100%	0%	0%	0%	0%	0%	0%	0%
Butale-Monokolo	100%	0%	0%	0%	0%	0%	0%	0%
Kamonyi	83%	17%	17%	0%	0%	0%	0%	0%
Katuna	40%	20%	0%	20%	0%	0%	20%	0%
Kirumbu	100%	0%	0%	0%	0%	0%	0%	0%
Kivuye	100%	0%	0%	0%	0%	0%	0%	0%
Luhanga	----	----	----	----	----	----	----	----
Rugarama	----	----	----	----	----	----	----	----
St. Benoit	100%	0%	0%	0%	0%	0%	0%	0%
Displacement Status								
Resident	83%	17%	8%	0%	0%	0%	0%	0%
IDP	78%	0%	0%	11%	0%	0%	11%	0%
Area								
Rural	81%	10%	5%	5%	0%	0%	5%	0%
Urban	----	----	----	----	----	----	----	----

Table 45: Location where respondents experiencing illness sought care in the 30 days before the survey, Mweso health zone, North Kivu, DRC (November 2021)

	% of patients by type of health facility where the patient sought care						
	Health center	Hospital	Pharmacy	Health post	Traditional healer	Private doctor	Mobile clinic
Total	63%	17%	14%	8%	2%	2%	0%
Age							
18 to 25	66%	17%	16%	2%	6%	0%	1%
26 to 35	62%	15%	14%	11%	0%	3%	0%
36 to 45	61%	16%	14%	9%	2%	4%	0%
46 and over	65%	19%	12%	9%	1%	1%	0%
Person at risk (over 55)							
No	64%	16%	14%	7%	2%	2%	0%
Yes	61%	20%	16%	9%	2%	0%	0%
Sex							
Women	65%	19%	13%	5%	2%	3%	1%
Men	60%	12%	16%	12%	3%	1%	0%
Health Area							
Bibwe	45%	50%	5%	0%	0%	0%	0%
Bukama	88%	0%	6%	0%	6%	0%	0%
Butale-Monokolo	59%	19%	19%	16%	3%	0%	0%
Kamonyi	90%	2%	2%	5%	2%	0%	0%
Katuna	53%	8%	35%	8%	3%	0%	0%
Kirumbu	60%	25%	15%	5%	5%	0%	0%
Kivuye	67%	11%	22%	11%	0%	0%	0%
Luhanga	62%	0%	31%	0%	8%	0%	0%
Rugarama	60%	20%	8%	10%	1%	6%	1%
St. Benoit	40%	40%	40%	0%	0%	0%	0%
Displacement Status							
Resident	63%	15%	15%	9%	2%	2%	0%
IDP	65%	24%	10%	4%	3%	1%	0%
Area							
Rural	63%	14%	15%	9%	3%	2%	0%
Urban	65%	25%	11%	3%	0%	2%	0%

Table 46: Proportion of households with illness events during the first months of COVID-19 restrictions (March-May 2020), health seeking care behavior and reported symptoms, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents who reported being sick	% who sought care among those who were sick	% of respondents or children who felt sick during the first months of the restrictions in place against COVID-19, by symptom										
			Fever	Cough	Chronic headaches	Acute diarrhea	Breathing difficulty	Malaria	Dermatosis	Physical pain	Itching scabies	Other	Does not know / Has not been diagnosed
Total	23%	97%	71%	31%	26%	19%	14%	0%	0%	0%	0%	10%	1%
Age													
18 to 25	17%	97%	82%	18%	15%	15%	15%	0%	0%	0%	0%	6%	3%
26 to 35	27%	98%	70%	27%	21%	23%	13%	0%	0%	0%	0%	7%	0%
36 to 45	26%	96%	61%	36%	18%	29%	21%	0%	0%	0%	0%	18%	0%
46 and over	24%	94%	71%	46%	51%	9%	9%	0%	0%	0%	0%	11%	0%
Person at risk (over 55)													
No	24%	98%	71%	30%	22%	20%	14%	0%	0%	0%	0%	10%	1%
Yes	17%	87%	73%	40%	60%	7%	7%	0%	0%	0%	0%	7%	0%
Sex													
Women	21%	96%	74%	31%	27%	27%	11%	0%	0%	0%	0%	11%	0%
Men	29%	98%	67%	30%	25%	8%	17%	0%	0%	0%	0%	8%	2%
Health Area													
Bibwe	17%	89%	78%	33%	44%	33%	11%	0%	0%	0%	0%	0%	0%
Bukama	16%	100%	60%	40%	40%	20%	60%	0%	0%	0%	0%	20%	0%
Butale-Monokolo	21%	100%	73%	33%	20%	33%	0%	0%	0%	0%	0%	0%	0%
Kamonyi	22%	89%	63%	32%	42%	11%	32%	0%	0%	0%	0%	5%	0%
Katuna	29%	100%	62%	38%	23%	27%	15%	0%	0%	0%	0%	12%	0%
Kirumbu	25%	100%	64%	27%	27%	27%	18%	0%	0%	0%	0%	0%	9%
Kivuye	25%	100%	100%	38%	13%	25%	0%	0%	0%	0%	0%	0%	0%
Luhanga	26%	83%	67%	0%	0%	17%	33%	0%	0%	0%	0%	17%	0%
Rugarama	23%	98%	74%	30%	26%	11%	6%	0%	0%	0%	0%	17%	0%
St. Benoit	29%	100%	86%	14%	14%	0%	0%	0%	0%	0%	0%	14%	0%
Displacement Status													
Resident	22%	96%	72%	30%	25%	16%	13%	0%	0%	0%	0%	9%	0%
IDP	27%	98%	70%	33%	28%	26%	16%	0%	0%	0%	0%	12%	2%
Area													
Rural	25%	97%	70%	31%	26%	20%	15%	0%	0%	0%	0%	9%	1%
Urban	18%	96%	79%	29%	25%	13%	8%	0%	0%	0%	0%	13%	0%

Table 47: Location where respondents experiencing illness during the first months of COVID-19 restrictions (March – May 2020) sought care, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents by place where they sought care								
	Health center	Hospital	Pharmacy	Health post	Traditional healer	Mobile clinic	Private doctor	Other	Don't know / don't want to answer
Total	67%	20%	17%	12%	1%	1%	0%	0%	0%
Age									
18 to 25	71%	29%	9%	3%	6%	0%	0%	0%	0%
26 to 35	70%	11%	21%	13%	0%	0%	0%	0%	0%
36 to 45	68%	25%	14%	14%	0%	0%	0%	0%	0%
46 and over	60%	23%	20%	20%	0%	3%	0%	0%	0%
Person at risk (over 55)									
No	67%	20%	16%	12%	1%	1%	0%	0%	0%
Yes	67%	20%	27%	13%	0%	0%	0%	0%	0%
Sex									
Women	71%	21%	17%	10%	2%	1%	0%	0%	0%
Men	62%	19%	17%	16%	0%	0%	0%	0%	0%
Health Area									
Bibwe	56%	44%	0%	0%	0%	0%	0%	0%	0%
Bukama	80%	0%	40%	20%	0%	0%	0%	0%	0%
Butale-Monokolo	47%	13%	0%	33%	7%	0%	0%	0%	0%
Kamonyi	95%	11%	5%	5%	0%	0%	0%	0%	0%
Katuna	69%	8%	27%	12%	0%	0%	0%	0%	0%
Kirumbu	55%	45%	36%	0%	0%	0%	0%	0%	0%
Kivuye	63%	25%	13%	13%	0%	0%	0%	0%	0%
Luhanga	83%	0%	33%	0%	0%	0%	0%	0%	0%
Rugarama	68%	26%	17%	15%	2%	2%	0%	0%	0%
St. Benoit	43%	29%	14%	14%	0%	0%	0%	0%	0%
Displacement Status									
Resident	72%	15%	19%	15%	0%	1%	0%	0%	0%
IDP	56%	33%	12%	5%	5%	0%	0%	0%	0%
Area									
Rural	66%	19%	16%	13%	2%	1%	0%	0%	0%
Urban	75%	25%	21%	8%	0%	0%	0%	0%	0%

Table 48: Proportion of households reporting vaccinating their children during the first months of the COVID-19 restrictions and reason for not vaccinating children, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents having vaccinated their children (routine vaccination)			Reasons of not having their children vaccinated (routine vaccination)					
	Yes	No	Don't know / don't want to answer	Vaccination services were not offered	Household was worried about COVID-19 infections	Household had other commitments	Don't know / don't want to answer	Some vaccination campaigns have been interrupted	Other
Total	79%	21%	1%	22%	21%	5%	5%	5%	44%
Age									
18 to 25	82%	18%	1%	34%	23%	11%	9%	6%	20%
26 to 35	84%	16%	----	35%	29%	6%	6%	9%	18%
36 to 45	78%	21%	1%	13%	43%	0%	0%	9%	48%
46 and over	68%	30%	2%	7%	2%	2%	5%	0%	84%
Person at risk (over 55)									
No	82%	18%	0%	26%	27%	6%	5%	7%	34%
Yes	59%	37%	3%	9%	3%	3%	6%	0%	78%
Sex									
Women	78%	21%	1%	26%	16%	6%	5%	5%	44%
Men	80%	19%	1%	15%	34%	2%	5%	5%	46%
Health Area									
Bibwe	79%	21%	----	0%	18%	9%	9%	18%	55%
Bukama	81%	16%	3%	0%	60%	0%	0%	0%	40%
Butale-Monokolo	71%	29%	----	24%	33%	5%	10%	5%	29%
Kamonyi	75%	23%	2%	15%	20%	15%	5%	15%	45%
Katuna	83%	16%	1%	36%	21%	0%	0%	7%	36%
Kirumbu	86%	14%	----	0%	50%	0%	0%	0%	50%
Kivuye	78%	22%	----	0%	29%	0%	0%	0%	71%
Luhanga	87%	13%	----	0%	33%	33%	0%	0%	33%
Rugarama	79%	20%	0%	41%	5%	2%	7%	0%	44%
St. Benoit	71%	29%	----	0%	29%	0%	0%	0%	71%
Displacement Status									
Resident	77%	22%	1%	22%	20%	5%	4%	4%	47%
IDP	85%	15%	----	22%	30%	4%	9%	9%	30%
Area									
Rural	80%	19%	1%	15%	28%	6%	4%	7%	45%
Urban	72%	27%	1%	41%	5%	3%	8%	0%	43%

4.4.8 Social interactions

Quantitative results

Tables 49 to 53 describe social interactions the day before the survey, as reported by the household survey respondents.

The mean number of interactions was 2 (SD=1), ranging between 1 and 5. There was no variation across sex, age, setting, displacement status. Most respondents (68%) had only 1 to 2 interactions while 26% had 3 to 4 and only 5% had 5 or more interactions. The area of Butale-Monokolo had the most interactions with 11% having 5 or more interactions. Almost all (91%) participants reported having interactions that included physical contact in the last 24 hours. People at risk and people over 46 years of age reported more often that their interactions did not include physical contact. There was little variation between sex, setting or displacement status. The most common interaction was that with a friend (47%) followed by another household member (35%). This trend stayed consistent for all demographics except in Bukama area. Men interacted with friends more than women.

Most respondents reported having interactions with producer/farmers (66%) followed by students (9%) and children (6%). The most common overall place of interaction was respondents' homes (51%) followed by another home (16%) and walking (14%). This trend was found in every demographic except those at high risk (55+) and those 46+ years where interaction at work (17% and 12%) were more common than those walking (5% and 10%). Women had more interactions in the home and at another home than men whereas men had more interactions walking or at work. Movement seemed least restrictive in Monokolo where people interacted more in shops and places of leisure.

Overall most respondents report having their interactions inside (58%) compared with outside (42%). Every sub-group reported more interactions inside than outside however, the largest discrepancy was found in Bukama, Kivuye, and Luhanga were 71% reported interactions outside while only 29% report interactions inside. Most respondents (47%) reported having interactions of 15 minutes to 1 hour and this was common across all sub-groups.

Slightly more than half of the respondents (55%) said it would have not been possible to have the interaction remotely. Across sub-groups those with the biggest variation were in Monokolo (74% no, 26% yes), Bibwe (65% no, 35% yes), and displaced populations (70% no, 30% yes). The most common reason for this was that the meeting required physical contact (49%) and the lack of access to a phone (30%). More displaced people cited that they preferred to meet in person compared to residents. Almost no one responded no internet and no phone credit as the reasoning for not meeting virtually.

Most respondents (87%) report no one in the interaction to be wearing a mask. The most common place where both people are wearing a mask was Bukama (18%). There was no variation amongst the other subgroups. Displaced persons had lower odds of wearing a mask compared to residents (table 55).

Most respondents (54%) report daily interactions. People in the Butale-Monokolo area were the most restrictive with only 27% meeting daily. Persons at risk (over 55) report the lowest percentage of respondent meeting with a contact daily (48%) and instead report meeting the contact a least once a week

(41%). Of those who did not meet daily, one third met weekly (37%) and 9% met at least once in the last month.

Most people reported having a normal day yesterday (76%). Displaced people (33%), women (27%) and the urban (25%) were those groups who experienced the most change to their days. If there was a difference in day, the most common difference was reported to be fewer interactions than normal (81%). People 46+ years did express that their days were different because they had experienced an emergency the day before (16%) and not as many experienced fewer interactions. 100% of respondents from Bukama reported the difference to be fewer interactions. There were minimal respondents who claim the difference due to doing their shopping or not interacting with anyone at all.

When asked about social interactions during the months with COVID-19 restrictions (i.e., between March and August 2020) (table 54), a little less than half of respondents (44%) reported restrictions of meetings as the most common change in the number of their interactions, with slightly higher figures for women than men. However, 24% of respondents reported having little or no change to their interactions during COVID-19. More respondents who were at risk (over 55+years) reported little or no change compared with respondents who were not at risk (29% vs 23%). All subgroups have minimal respondents report observing change in interactions. Luhanga (26%) and Katuna (24%) reported the most observed changes among all sub-groups of respondents. About half (46%) of respondents reported shortening the duration of interactions with very little variation amongst the subgroups except in the area Monokolo which reported 69% shorter interactions.

Qualitative results

The majority of the population was worried about social interactions during confinement. Nevertheless, these relationships (work, market or even religious worship) were perceived as inevitable by many groups and were then frequented all the same.

- At work, people can't avoid encounters and have to keep working. Half of the groups reported meeting for work. These meetings generate fears (in relation to the transmission of the disease and/or fear of the authorities) for half of the respondents.
- Half of the groups reported meeting for leisure. Being non-essential activities, the proportion of respondents affirming that it is possible to avoid these encounters is almost unanimous. For a quarter of the groups, leisure activities are beginning to resume.
- In the context of religious worship, the already mentioned closure of places of worship has prevented people from meeting. We also find the concern mentioned in the other encounter frameworks. More than half of the groups mention prayer meetings that took place during the pandemic.
- Many groups were saying that the schools were already closed because the teachers are on strike. A few groups said schools were closed but reopened with measures like students wearing masks.
- In the context of the markets, some groups reported that the markets were still functional during the containment measures. Depending on the location, the animation of the markets has not changed or has been modified by the measures.

There were some groups that said people saw each other as often as usual, but most groups expressed that people saw each other less often during the time of the restrictions. Specifically, the elderly was avoided so as not to transmit COVID-19 to them. All groups said the number of people in the household was high during the pandemic. It was mainly because of the closure of schools, and the closure of work. As for events, such as weddings, half of the groups said they were no longer organized while the other half expressed that these kinds of events were still organized during the pandemic, but smaller. No more activities were organized, and cafes and restaurants were closed during the pandemic according to most groups. A minority indicated that there are no such activities and services in their communities. All but one group agreed that the impact following the pandemic has been negative, as they have become poor and because life has become difficult.

Relevant Quotes:

"Young people were afraid to associate with the elderly"

(male from Katuna village, age 18-30) (FGD 2)

« It is impossible not to meet because we have to work by being together"

(woman from Kinshanga village, age 30-59) (FGD 7)

Table 49: Overview of household survey respondent interactions, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondent's interactions with physical contact, during the last 24 hours			% of respondents by number of interactions			Average % of interactions of the person surveyed by relationship with contact						
	Yes	No	Don't know/ don't want to answer	1 to 2	3 to 4	5 and more	Friend	Household Member	Other relative	Coworker	Professional contacts	School friend	Does not want to answer /Does not know
Total	91%	9%	0%	68%	26%	5%	47%	35%	12%	2%	2%	0%	0%
Age													
18 to 25	93%	7%	1%	66%	29%	5%	49%	34%	13%	2%	1%	1%	0%
26 to 35	91%	9%	0%	69%	25%	6%	50%	30%	13%	2%	3%	0%	0%
36 to 45	91%	8%	0%	65%	28%	7%	43%	41%	12%	1%	1%	0%	0%
46 and over	87%	13%	0%	74%	23%	3%	44%	39%	11%	3%	2%	0%	0%
Person at Risk (Over 55)													
No	92%	8%	0%	67%	27%	6%	48%	34%	13%	2%	1%	0%	0%
Yes	85%	15%	0%	80%	19%	1%	41%	42%	9%	4%	3%	0%	0%
Sex													
Women	91%	9%	0%	68%	28%	4%	44%	37%	14%	1%	1%	0%	0%
Men	91%	8%	0%	69%	24%	7%	53%	31%	8%	4%	3%	0%	0%
Health Area													
Bibwe	89%	11%	0%	79%	17%	4%	50%	30%	17%	0%	0%	0%	0%
Bukama	91%	9%	0%	84%	16%	----	38%	40%	18%	0%	2%	1%	0%
Butale-Monokolo	90%	10%	0%	63%	26%	11%	49%	32%	9%	3%	4%	1%	0%
Kamonyi	90%	10%	0%	74%	23%	3%	47%	34%	15%	2%	1%	1%	0%
Katuna	94%	5%	1%	55%	39%	6%	47%	33%	12%	3%	2%	0%	0%
Kirumbu	86%	14%	0%	66%	30%	5%	47%	42%	11%	0%	0%	0%	0%
Kivuye	90%	7%	3%	81%	19%	----	44%	43%	9%	0%	3%	0%	0%
Luhanga	93%	7%	0%	61%	35%	4%	47%	37%	12%	3%	0%	0%	0%
Rugarama	91%	9%	0%	68%	27%	5%	48%	35%	11%	2%	2%	0%	0%
St. Benoit	92%	8%	0%	75%	17%	8%	53%	29%	15%	1%	0%	0%	0%
Displacement Status													
Resident	91%	9%	0%	66%	28%	6%	49%	35%	10%	2%	2%	0%	0%
IDP	92%	8%	0%	76%	20%	4%	42%	33%	20%	1%	1%	0%	0%
Area													
Rural	91%	9%	0%	70%	26%	4%	47%	35%	13%	2%	2%	0%	0%
Urban	91%	9%	0%	63%	29%	8%	49%	36%	8%	3%	2%	0%	0%

Table 50: Location of interactions, Mweso health zone, North Kivu, DRC (November 2021)

	Average % of interactions of the person surveyed by place of interaction with the contact									
	My home	Another home	Walking	At work	Shop/Market	Leisure place	Place of worship	School	Community Building	Other/ Don't know
Total	51%	16%	14%	8%	3%	2%	2%	2%	1%	0%
Age										
18 to 25	47%	14%	18%	8%	6%	2%	1%	3%	1%	0%
26 to 35	47%	18%	14%	9%	3%	1%	3%	2%	2%	0%
36 to 45	57%	18%	14%	3%	1%	3%	2%	0%	0%	1%
46 and over	59%	13%	10%	12%	2%	3%	2%	0%	0%	0%
Person at risk (over 55)										
No	50%	16%	15%	7%	4%	2%	2%	2%	1%	0%
Yes	55%	13%	5%	17%	2%	4%	3%	0%	0%	0%
Sex										
Women	59%	15%	11%	7%	3%	1%	1%	1%	2%	0%
Men	35%	18%	21%	12%	3%	4%	4%	3%	0%	0%
Health Area										
Bibwe	43%	25%	15%	8%	0%	4%	4%	2%	0%	0%
Bukama	48%	33%	11%	8%	0%	0%	0%	0%	0%	0%
Butale-Monokolo	32%	15%	26%	10%	7%	3%	1%	3%	2%	0%
Kamonyi	41%	22%	17%	10%	3%	1%	0%	5%	2%	0%
Katuna	62%	11%	10%	6%	3%	2%	6%	1%	0%	0%
Kirumbu	48%	22%	16%	7%	5%	2%	1%	0%	0%	0%
Kivuye	55%	13%	21%	5%	2%	2%	0%	2%	0%	0%
Luhanga	50%	8%	16%	4%	3%	3%	9%	0%	8%	0%
Rugarama	58%	11%	10%	10%	4%	3%	1%	1%	1%	0%
St. Benoit	59%	16%	11%	10%	0%	2%	2%	2%	0%	0%
Displacement Status										
Resident	52%	16%	13%	8%	4%	3%	2%	2%	2%	0%
IDP	49%	17%	17%	11%	2%	1%	2%	2%	0%	0%
Area										
Rural	49%	17%	16%	7%	3%	2%	2%	2%	1%	0%
Urban	58%	12%	7%	12%	6%	2%	0%	2%	1%	0%

Table 51: Household survey respondents use of mask and communication, Mweso health zone, North Kivu, DRC (November 2021)

	Location of interaction		Duration of the interaction				Wearing the mask during the previous' day interaction					Would have been possible to communicate otherwise?	
	Inside	Outside	Less than 15 mins	15 mins - 1 hour	1 - 4 hours	More than 4 hours	No – none of us	Yes – both of us	Yes – only me	Yes – only contact	Don't know / don't want to answer	No	Yes
Total	58%	42%	29%	47%	19%	5%	87%	6%	4%	2%	0%	55%	45%
Age													
18 to 25	54%	46%	26%	47%	22%	5%	88%	6%	3%	2%	0%	52%	48%
26 to 35	55%	45%	27%	48%	18%	6%	89%	5%	3%	2%	0%	56%	44%
36 to 45	64%	36%	37%	52%	11%	1%	87%	7%	3%	2%	1%	54%	46%
46 and over	63%	37%	33%	41%	22%	5%	83%	8%	5%	3%	0%	59%	41%
Person at risk (over 55)													
No	58%	42%	29%	48%	18%	5%	88%	6%	3%	2%	0%	55%	45%
Yes	61%	39%	32%	38%	24%	7%	81%	9%	8%	2%	1%	59%	41%
Sex													
Women	59%	41%	32%	46%	18%	4%	88%	6%	4%	2%	0%	58%	42%
Men	56%	44%	24%	48%	21%	7%	86%	7%	4%	3%	0%	50%	50%
Health Area													
Bibwe	63%	37%	27%	54%	17%	1%	93%	4%	2%	0%	1%	65%	35%
Bukama	71%	29%	31%	50%	19%	0%	77%	18%	5%	0%	0%	49%	51%
Butale-Monokolo	43%	57%	39%	42%	18%	1%	90%	3%	4%	2%	1%	74%	26%
Kamonyi	55%	45%	24%	58%	12%	7%	89%	6%	1%	4%	0%	55%	45%
Katuna	63%	37%	27%	46%	22%	6%	82%	11%	5%	2%	0%	50%	50%
Kirumbu	58%	43%	24%	50%	23%	3%	93%	5%	0%	3%	0%	60%	40%
Kivuye	71%	29%	38%	41%	14%	6%	84%	2%	14%	0%	0%	50%	50%
Luhanga	71%	29%	16%	46%	35%	3%	89%	8%	3%	0%	0%	46%	54%
Rugarama	57%	43%	32%	42%	18%	7%	87%	6%	4%	2%	0%	52%	48%
St. Benoit	51%	49%	26%	46%	24%	4%	90%	2%	2%	6%	0%	45%	55%
Displacement Status													
Resident	56%	44%	30%	47%	18%	4%	86%	8%	4%	2%	0%	51%	49%
IDP	64%	36%	27%	46%	20%	7%	91%	2%	3%	3%	0%	70%	30%
Area													
Rural	59%	41%	27%	49%	20%	4%	87%	7%	4%	2%	0%	57%	43%
Urban	56%	44%	37%	40%	16%	7%	89%	6%	4%	2%	0%	47%	53%

Table 52: Reason for in-person interactions by household survey respondents, Mweso health zone, North Kivu, DRC (November 2021)

	% of interactions of the person surveyed by reason for not having the meeting remotely								
	It required physical contact	No phone access	We prefer to meet in person	The subject of the meeting was sensitive	No phone credit	No internet access	Don't know / don't want to answer	Other	Do not trust the phone/ internet for calls
Total	49%	30%	26%	9%	3%	1%	1%	0%	0%
Age									
18 to 25	46%	36%	28%	6%	3%	1%	2%	0%	0%
26 to 35	51%	25%	27%	8%	4%	2%	0%	1%	0%
36 to 45	47%	33%	30%	11%	0%	0%	0%	0%	0%
46 and over	54%	29%	21%	12%	2%	0%	0%	0%	1%
Person at risk (over 55)									
No	49%	30%	27%	9%	3%	1%	1%	0%	0%
Yes	53%	29%	23%	10%	2%	0%	0%	0%	0%
Sex									
Women	47%	30%	27%	8%	2%	1%	1%	0%	0%
Men	55%	31%	26%	10%	4%	1%	1%	0%	0%
Health Area									
Bibwe	53%	31%	27%	5%	0%	0%	0%	0%	0%
Bukama	63%	16%	29%	11%	0%	0%	0%	0%	0%
Butale-Monokolo	46%	42%	17%	6%	6%	3%	2%	2%	0%
Kamonyi	55%	26%	31%	9%	0%	0%	0%	0%	1%
Katuna	45%	29%	30%	6%	4%	0%	0%	0%	0%
Kirumbu	44%	26%	36%	11%	0%	0%	2%	0%	0%
Kivuye	46%	17%	36%	7%	0%	0%	6%	0%	0%
Luhanga	38%	36%	37%	14%	0%	0%	0%	0%	0%
Rugarama	51%	31%	21%	10%	4%	2%	0%	0%	0%
St. Benoit	44%	27%	41%	19%	0%	0%	0%	0%	0%
Displacement Status									
Resident	53%	30%	23%	10%	3%	1%	0%	0%	0%
IDP	41%	30%	34%	6%	3%	1%	1%	0%	0%
Area									
Rural	48%	31%	27%	8%	2%	1%	1%	0%	0%
Urban	55%	25%	25%	11%	4%	3%	0%	0%	0%

Table 53: Characteristics of previous contacts by household survey respondents, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents having a normal day yesterday	% of respondents by difference of the day (compared to normal)							% of respondent's interactions with contact in the last 30 days by number of times			
		Fewer interactions	Emergency yesterday	More interactions	Other	Unusual – I had an interaction	Walking/ shopping day	Unusual – no interaction	Daily	At least once a week	At least once	Never met this contact before
Total	76%	81%	8%	7%	3%	3%	1%	1%	54%	37%	9%	0%
Age												
18 to 25	78%	86%	5%	7%	0%	5%	0%	0%	54%	40%	6%	0%
26 to 35	76%	82%	6%	12%	2%	0%	2%	2%	54%	39%	7%	0%
36 to 45	78%	88%	4%	0%	8%	0%	0%	0%	56%	33%	10%	1%
46 and over	73%	68%	16%	5%	5%	8%	3%	0%	52%	35%	13%	0%
Person at risk (55+)												
No	77%	83%	6%	8%	2%	3%	1%	1%	54%	37%	8%	0%
Yes	76%	67%	19%	5%	10%	5%	5%	0%	48%	41%	10%	0%
Sex												
Women	73%	83%	5%	7%	3%	2%	2%	1%	54%	38%	8%	0%
Men	83%	73%	16%	8%	3%	8%	0%	0%	53%	36%	10%	1%
Health area												
Bibwe	77%	83%	0%	0%	17%	0%	0%	8%	62%	29%	6%	2%
Bukama	78%	100%	0%	0%	0%	0%	0%	0%	64%	30%	7%	0%
Butale-Monokolo	71%	76%	10%	24%	0%	0%	0%	0%	27%	56%	16%	0%
Kamonyi	77%	68%	21%	0%	5%	16%	0%	0%	62%	29%	8%	0%
Katuna	78%	85%	5%	10%	0%	0%	0%	0%	59%	37%	4%	0%
Kirumbu	73%	83%	0%	8%	0%	0%	8%	0%	53%	35%	12%	0%
Kivuye	75%	88%	0%	0%	0%	13%	0%	0%	67%	31%	2%	0%
Luhanga	74%	83%	33%	0%	0%	17%	0%	0%	62%	38%	0%	0%
Rugarama	80%	80%	3%	8%	5%	0%	3%	0%	52%	39%	9%	0%
St. Benoit	63%	78%	22%	0%	0%	0%	0%	0%	45%	39%	16%	0%
Displacement status												
Resident	79%	77%	12%	8%	3%	5%	1%	0%	53%	39%	8%	0%
IDP	67%	87%	0%	6%	4%	0%	2%	2%	56%	34%	11%	0%
Area												
Rural	75%	80%	9%	6%	4%	4%	2%	1%	54%	36%	9%	0%
Urban	81%	85%	0%	12%	0%	0%	0%	0%	52%	42%	6%	0%

Table 54: Changes in interactions during the months with COVID-19 restrictions (March to August 2020) in terms of types and duration, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents by changes in their interactions							% of respondents according to the evolution of their interactions (duration)							
	Meeting restrictions	Little/no change	Observed changes	No more meetings	Isolation	Other	More meetings	Shorter	Little/no change	Other	Unrelated Response	Longer	Observed change	No answer	No more meetings
Total	44%	24%	14%	9%	6%	3%	0%	46%	25%	7%	6%	6%	6%	2%	2%
Age															
18 to 25	43%	24%	15%	7%	7%	4%	----	47%	23%	8%	7%	7%	6%	----	4%
26 to 35	41%	26%	15%	11%	5%	1%	----	43%	28%	6%	6%	6%	5%	4%	0%
36 to 45	49%	17%	17%	9%	6%	2%	1%	44%	28%	7%	5%	6%	9%	1%	----
46 and over	44%	25%	10%	8%	8%	4%	----	50%	22%	9%	6%	5%	3%	3%	2%
Person at risk (over 55)															
No	44%	23%	15%	9%	6%	2%	0%	46%	26%	7%	6%	6%	6%	2%	2%
Yes	42%	29%	12%	6%	7%	5%	----	50%	21%	8%	7%	6%	3%	2%	2%
Sex															
Women	46%	24%	13%	9%	4%	4%	0%	46%	26%	8%	5%	6%	5%	2%	2%
Men	39%	24%	18%	9%	10%	1%	----	46%	25%	6%	7%	6%	6%	2%	2%
Health Area															
Bibwe	40%	33%	13%	10%	4%	----	----	44%	33%	6%	8%	8%	2%	----	----
Bukama	34%	31%	16%	13%	----	6%	----	44%	34%	9%	3%	6%	3%	----	----
Butale-Monokolo	76%	15%	----	6%	3%	----	----	69%	21%	----	----	7%	----	3%	----
Kamonyi	41%	26%	15%	8%	6%	3%	----	44%	28%	8%	7%	9%	2%	1%	1%
Katuna	39%	17%	24%	7%	10%	3%	----	45%	19%	9%	6%	6%	11%	1%	3%
Kirumbu	32%	27%	20%	9%	9%	2%	----	39%	32%	11%	9%	2%	2%	----	5%
Kivuye	41%	19%	19%	13%	9%	----	----	47%	28%	6%	9%	6%	3%	----	----
Luhanga	35%	26%	26%	13%	----	----	----	39%	35%	9%	9%	----	4%	4%	----
Rugarama	42%	24%	13%	9%	7%	4%	0%	45%	22%	8%	7%	4%	9%	3%	1%
St. Benoit	42%	33%	8%	13%	4%	----	----	29%	29%	8%	----	8%	8%	8%	8%
Displacement Status															
Resident	45%	21%	15%	10%	5%	3%	0%	46%	23%	9%	7%	6%	6%	3%	2%
IDP	39%	34%	13%	4%	8%	2%	----	46%	33%	3%	4%	6%	5%	1%	2%
Area															
Rural	44%	23%	15%	9%	7%	2%	0%	47%	25%	8%	6%	6%	4%	2%	2%
Urban	42%	28%	12%	7%	4%	6%	----	44%	25%	7%	4%	5%	10%	4%	----

Table 55: Factors associated with wearing a mask in the interactions the day before the survey, Mweso health zone, DRC

N = 510	Odds ratio	Confidence Interval	p Value
Sex (ref male)			
Female	1.056257	.5237197 - 2.130296	0.878
Age (ref 18-29)			
30-59	.7636292	.3924394 - 1.48591	0.427
60+	1.58555	.5602632 - 4.487122	0.385
Setting (ref urban)			
Rural	1.345949	.6067992 - 2.985465	0.465
Displacement Status (ref residents)			
Displaced	**.3691157**	**.1409617 - .9665485**	**0.042**
Education (ref none)			
Primary	1.417853	.6555569 - 3.066563	0.375
Secondary	1.69305	.7307356 - 3.922647	0.219
University	1.695259	.1867692 - 15.38746	0.639

Note: results in bold are statistically significant at 0.005 level.

4.4.9 Access to WASH

Quantitative results

Tables 56 and 57 describe the household survey respondents' access to WASH. Over half (58%) of the respondents reported not having access to a functional handwashing device (HWD). People in urban areas had better access than in rural (51% vs 40%) and there was variation between areas (35%-78% of respondents without access to hand washing facility). Less than a third (26%) had access to a handwashing device at home but people over 46 years had better access with 36% having facilities at home. There was a great disparity between areas with Kamonyi, Luhanga and Kivuye having less than 10 of respondents having access to handwashing at home.

Most respondents report not having access to a functional handwashing device before COVID-19 (78%) which shows that access to handwashing devices increased during the pandemic. 90% of respondents in Kivuye and 89% of respondents from Kirumbu reported not having access to handwashing devices before COVID-19 and that has improved greatly during the pandemic. Most respondents (57%) reported washing their hands more often during the pandemic although persons at risk and people over 46 years showed less change in behavior. There was a large variation between the areas. At least one third of people (33%) washed their hands less frequently since the beginning of the pandemic with women washing their hands less frequently than men (36% versus 27%). 10% of total respondents indicated no change at all.

Almost all respondents (95%) reported having a handwashing device set up in the community to raise awareness of hand washing to reduce the risk of spreading the COVID-19. There was some variation amongst areas as well as between displaced and residents. Most people (85%) think that the community

uses a functional handwashing device on a regular basis to avoid spreading COVID-19. Responses ranged between 100% in Bukama and Kuhanga and 74% in Katuna.

The most common reason for not having access to a functional HWD Is financial means: water is too expensive (65%) and soap is too expensive (11%). People over 46 years and at risk (over 55+ years) indicated that other reasons were the distance to the water point being too great (7% and 12% respectively). Displaced people found financial obstacles to water and soap to be greater than residents; likewise urban were more financially limited than rural.

Qualitative results: Access to WASH since the beginning of the pandemic

Washing hands is common after the toilet, before eating, after changing diapers and this measure is said to be the most applied because it protects against several other disease such as diarrhea and cholera but not because of COVID-19. Lack of financial means to buy soap was frequently reported. In Bweru the groups reported that poverty has limited the access of handwashing also because they don't have the means to get to facilities and that looting of sanitary facilities has limited their access to WASH.

Relevant Quotes:

"These methods are effective but difficult to be adopted by the community, some of them are easy like washing your hands regularly, wearing a face mask and others are difficult like avoiding physical contact." (female from Mokoto Village, aged 18-30) (FGD 10)

Table 56: Respondents access to WASH in the community, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents with access to a functional handwashing device (improved source and soap)				% of respondents having the device available before COVID-19			% of respondents by change in handwashing device use compared to before COVID-19			% of respondents reporting community use of handwashing device on a regular basis			% of respondents with community handwashing device set up to raise awareness of reducing the risk of COVID-19		
	No	Yes, at home	Yes, in community	Don't know / no answer	No	Yes	Don't know / no answer	More often	Less often	As often as before	Yes	No	Don't know / no answer	Yes	No	Don't know / no answer
Total	58%	26%	16%	0%	78%	22%	0%	57%	33%	10%	85%	14%	1%	95%	5%	0%
Age																
18 to 25	58%	23%	18%	1%	74%	24%	1%	55%	25%	20%	80%	18%	2%	98%	2%	----
26 to 35	61%	25%	13%	0%	75%	25%	----	65%	35%	----	89%	11%	----	95%	5%	----
36 to 45	63%	21%	16%	----	83%	18%	----	57%	43%	----	80%	17%	3%	91%	6%	3%
46 and over	48%	36%	16%	1%	81%	19%	----	50%	36%	14%	89%	11%	----	93%	7%	----
Person at risk (over 55)																
No	59%	25%	16%	0%	77%	22%	0%	60%	31%	10%	85%	14%	1%	96%	4%	1%
Yes	49%	37%	13%	1%	79%	21%	----	44%	44%	11%	87%	13%	----	91%	9%	----
Sex																
Women	58%	26%	16%	0%	79%	21%	----	54%	36%	10%	87%	13%	1%	95%	5%	----
Men	56%	26%	16%	1%	76%	23%	1%	64%	27%	9%	82%	16%	1%	94%	4%	1%
Health Area																
Bibwe	35%	52%	13%	----	79%	21%	----	57%	43%	----	81%	19%	----	100%	----	----
Bukama	56%	28%	16%	----	79%	21%	----	----	100%	----	100%	----	----	91%	9%	----
Butale-Monokolo	51%	24%	22%	3%	85%	15%	----	40%	----	60%	80%	20%	----	89%	11%	----
Kamonyi	78%	7%	15%	----	68%	32%	----	67%	17%	17%	92%	8%	----	92%	8%	----
Katuna	57%	30%	12%	----	76%	24%	----	56%	44%	----	74%	26%	----	93%	3%	3%
Kirumbu	59%	30%	11%	----	89%	11%	----	----	100%	----	80%	13%	7%	94%	6%	----
Kivuye	69%	9%	22%	----	90%	10%	----	100%	----	----	78%	22%	----	100%	----	----
Luhanga	74%	9%	17%	----	67%	33%	----	100%	----	----	100%	----	----	100%	----	----
Rugarama	53%	31%	15%	0%	73%	26%	1%	63%	29%	8%	91%	8%	2%	96%	4%	----
St. Benoit	58%	21%	21%	----	80%	20%	----	100%	----	----	88%	13%	----	100%	----	----
Displacement Status																
Resident	59%	26%	15%	1%	75%	25%	0%	56%	34%	10%	86%	14%	----	93%	6%	1%
IDP	53%	28%	19%	----	85%	15%	----	64%	27%	9%	84%	13%	3%	98%	2%	----
Area																
Rural	60%	25%	15%	0%	79%	21%	----	58%	33%	9%	83%	16%	1%	95%	5%	1%
Urban	49%	31%	20%	1%	72%	26%	1%	56%	33%	11%	92%	6%	2%	96%	4%	----

Table 57: Reasons for not having access to hand washing facilities, Mweso health zone, North Kivu, DRC (November 2021)

	% of respondents by reason for not having access to a functional handwashing device											
	No financial means	Other	Soap is too expensive	Distance to the water point is too great	Water quality is not good	Certain groups lack access to water sources	Difficult to access	Soap is not available at the market	Too dangerous	Water source is not working/ closed	Wait is too long / insufficient number of water sources	Water is not available at the market
Total	65%	19%	11%	5%	2%	2%	2%	1%	1%	1%	1%	0%
Age												
18 to 25	69%	14%	12%	3%	4%	3%	1%	0%	0%	2%	2%	0%
26 to 35	69%	15%	10%	6%	2%	2%	2%	2%	2%	2%	1%	0%
36 to 45	65%	22%	9%	4%	1%	1%	3%	3%	4%	1%	0%	0%
46 and over	51%	34%	12%	7%	0%	1%	0%	0%	0%	0%	1%	1%
Person at risk (over 55)												
No	67%	18%	10%	4%	3%	2%	2%	1%	1%	1%	1%	0%
Yes	50%	31%	14%	12%	0%	2%	0%	0%	0%	0%	2%	2%
Sex												
Women	65%	20%	10%	5%	2%	1%	2%	2%	1%	2%	1%	0%
Men	65%	18%	13%	7%	4%	3%	2%	1%	2%	0%	1%	0%
Health Area												
Bibwe	72%	22%	6%	6%	0%	0%	0%	0%	0%	0%	0%	0%
Bukama	89%	11%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Butale-Monokolo	59%	5%	22%	3%	0%	11%	0%	5%	3%	0%	3%	3%
Kamonyi	68%	19%	6%	9%	13%	0%	6%	0%	3%	1%	1%	0%
Katuna	55%	27%	12%	8%	0%	0%	2%	0%	2%	2%	2%	0%
Kirumbu	65%	23%	8%	4%	0%	0%	4%	0%	0%	8%	0%	0%
Kivuye	64%	18%	14%	5%	0%	5%	0%	0%	0%	0%	0%	0%
Luhanga	65%	29%	6%	6%	0%	0%	0%	0%	0%	0%	6%	0%
Rugarama	64%	20%	11%	4%	0%	2%	0%	3%	1%	1%	0%	0%
St. Benoit	71%	14%	21%	7%	0%	0%	0%	0%	0%	0%	0%	0%
Displacement Status												
Resident	62%	23%	9%	5%	3%	2%	2%	2%	1%	2%	1%	0%
IPD	75%	6%	18%	6%	0%	0%	1%	0%	1%	0%	1%	0%
Area												
Rural	67%	18%	12%	5%	3%	2%	2%	1%	2%	1%	1%	0%
Urban	54%	27%	7%	6%	0%	1%	0%	3%	0%	1%	0%	0%

5 Discussion

Our study in the northeastern province of North Kivu in DRC is one of a limited number of studies that investigate the epidemiology and effects of COVID-19 in unstable settings characterized by chronic insecurity and the presence of multiple armed groups. This study brings together complementary pieces of data to generate a more comprehensive understanding of the situation in Mweso health zone, DRC during the first year of the COVID-19 pandemic. Given the extensive effects that the COVID-19 pandemic has had on the entire society, this analysis remains partial as several other societal factors such as socio economic consequences or short term and long term effect due to lack of schooling were not included. Furthermore, the extensive data challenges, specifically for the epidemiological analysis and the assessment of changes in health care utilization, make it difficult to have a comprehensive picture of the situation.

The DRC declared a nationwide state of emergency due to COVID-19 two weeks after its first case was detected on March 10, 2020. [21] Between March 2020 and March 2021, about 28,199 confirmed COVID-19 cases were reported in DRC, with 745 deaths. [32] During the same period, a total of 2,213 confirmed COVID-19 cases and 244 deaths have been reported in North Kivu (as per MoH line list). Also during this period, the WHO daily situation reports from COVID-19 in North-Kivu recorded 2,057 confirmed COVID-19 cases. [32] The difference is probably due to delays in reporting as well as in obtaining test results. At the early stage of the pandemic, samples collected in North Kivu had to be transported to the national laboratory in Kinshasa causing late detection and long delay in the delivery of results. [33]

The epidemiological curve of infection in North Kivu in the first year of the COVID-19 pandemic shows two distinct waves in August 2020 and March 2021. These peaks occurred one month later than the national peaks, where most cases were reported in July 2020 and February 2021. This suggests a trajectory of infection from the capital Kinshasa (the first COVID-19 hotspot) to other parts of the country. The lag in reporting COVID-19 cases between Kinshasa and more remote areas of the country may be linked to the implementation of public health and social measures that may have slowed down the spread of the virus. The DRC declared the state of emergency only two weeks after the first case was detected in the country. Using lessons from Ebola virus disease outbreak, response measures were instituted including travel bans, widespread testing, quarantine, community-based contact tracing. [21] Lockdown was implemented in Kinshasa city and few selected regions to limit the movement of people. In terms of response structure, the same approach used for Ebola (i.e., one response lead by the MoH with thematic pillars supported by partners) was quickly introduced for COVID-19. Several aspects were relevant to the COVID-19 pandemic and the government built upon the Ebola experience, which represented an advantage for the DRC compared to other countries. [34]. However, the level of available financial support and presence of external technical partners were unfortunately much lower in this response compared to Ebola due to the wider spread of the disease in country and worldwide, requiring more resources and less in-country technical support from outside. As seen worldwide, the COVID-19 pandemic showed that even supposedly functioning health systems struggled to monitor the spread of the disease and respond to the pandemic. Localized support was unfortunately not sufficient to address a disease that spread as quickly as COVID-19, and questions remain as to how best to integrate a pillar response structure into the DRC health system.

From a demographic point of view, cases in North Kivu aligned with the global epidemiology of COVID-19 cases; most of the cases occurred among adults, and males as seen in other studies. [35, 36] Cases were not distributed proportionally across age groups; rather children under 5 years were underrepresented, and the elderly overrepresented. This discrepancy may be due to testing preference and access, with younger people being less open to testing, especially if asymptomatic or with mild symptoms. With regard to nationality, confirmed COVID-19 cases consisted almost exclusively of Congolese, and only 4.7% of the cases were identified in the context of travel. While the first case in both DRC and North Kivu was imported, the virus quickly spread among the communities, and local transmission soon became predominant in this region. In terms of geographical spread within the North Kivu province, the majority of the cases originate from the provincial capital Goma. This is likely linked to both higher population density as well as testing capacity initially concentrated in the provincial capital. Data on occupational risk is very limited as information about profession was available for only 6% of the cases. The higher proportion of HCWs among cases (63% of the cases for which information is available) is, therefore, likely biased. However, HCWs have been found to be at higher risk of infection due to increased exposure to confirmed and suspected cases. Prevalence of infections among HCWs varied extensively across countries, settings, and over time, but most of the studies are from Europe, North America and Asia. [37, 38] In a country like DRC where availability of health care professionals is well below WHO's recommended levels (0.28 physician per 10,000 population against 22.8 professional health workers per 10,000 [33]), a high incidence of COVID-19 among HCWs would strain the system beyond its already limited capacity to provide services. A study on occupational prevention and preparedness in three other DRC's provinces [39] reported high knowledge about the disease, infection channels and case management among HCWs; however, preventive practices were poorly implemented with less than half of health care workers using PPE. Stockouts of PPE and limited access of water remain a barrier to implement IPC measures in health facilities.

Little information about case management is available in the line list. A small proportion of cases needed hospitalization (3.5%), which is slightly lower than hospitalization rates reported from several other countries (ranging from 4% to 10%). [35] This could indicate that most COVID-19 cases in North Kivu presented with mild symptoms, as was noted in many other countries particularly with younger populations. Yet, given the incompleteness of data, this result may also be an underestimation. In addition, the CFR was high (11%), much higher than the estimated 2.6% CFR at the country level. [40] Similarly high CFRs have been reported among hospitalized cases in two studies in Kinshasa (13.2% [41] and 16% [42]). At provincial level, two other DRC provinces (Kwilu and North Ubangi) (figure 39) also reported high CFR. [43] While the CFR may be overestimated due to many cases going unreported, the increasing of cases coincided with the strike of HCWs involved in the response to COVID-19. In addition, oxygen capacity was limited and emergency services in remote areas of North Kivu are not easily accessible, increasing the risk of mortality for severe cases. Case fatality among the elderly was almost three times the CFR found in the total population, which confirms the higher mortality risk for elderly. However, CFR was 13% among the 0-17 year old cases, which is also much higher than what registered in most other countries. [35]

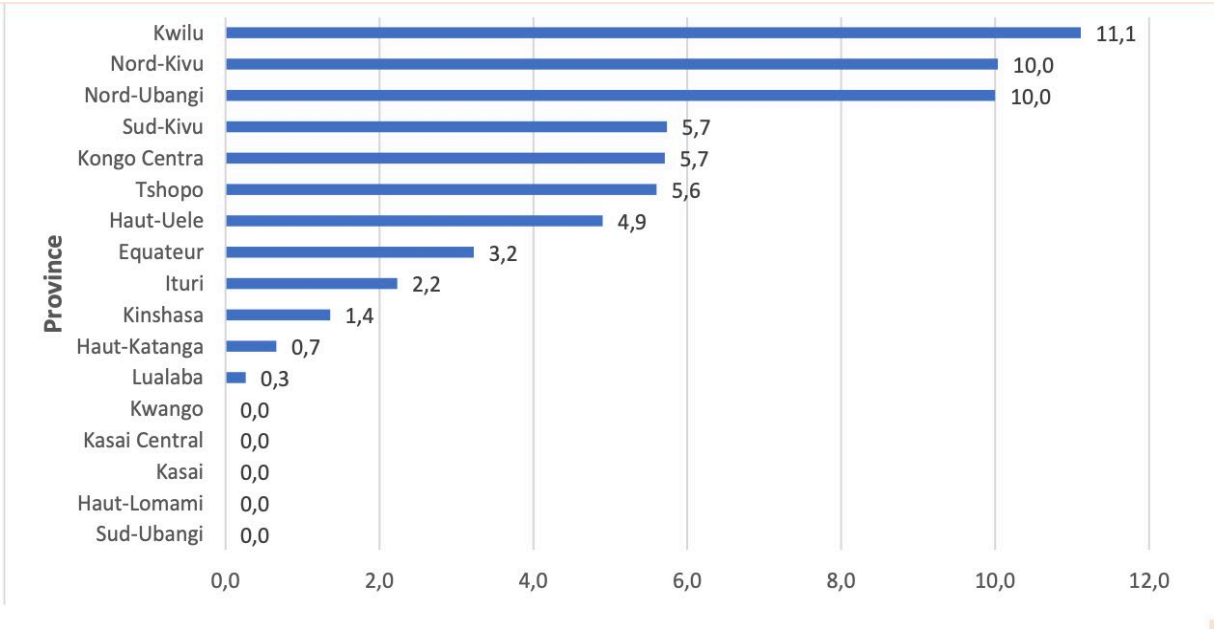

Figure 39: Distribution of case fatality rate of COVID-19 by province in Democratic Republic of Congo as of 28 march 2021

How the pandemic affected health care utilization is insufficiently studied and understood in many countries. It likely depends upon a myriad of factors including, but not limited to, how adaptations towards clinical services were implemented, government policies on quarantine and population movement and how they were enforced, personal behavior, trust amongst the population, as well as how RCCE programs were created and implemented.

We studied health care utilization of the population in Mweso health zone using interrupted time series models with data during the first year of the COVID-19 pandemic as well as qualitative methods amongst health care workers and residents of Mweso. We found mixed results, pointing to very different effects across health services. Child vaccination services were the most affected, with a consistent reduction in all subregions. This differs from results of a study conducted in Kinshasa [44], but in line with findings from Ahmed [45] and Shapira [46] at country level. The decrease found in the quantitative analysis also does not align with the survey respondents who reported vaccinating their children during the COVID-19 restrictions months. This can be due to recall bias. A minority of respondents indicated fear of COVID-19 infections as the main cause for postponing vaccination. The reduction in measles vaccination was accompanied with an important increase in measles cases over the same period. DRC had experienced an increase of measles cases since 2010, reaching the peak in 2019 with more than 311,000 cases, the highest in decades. [47] While aggregated numbers at country level show a reduction in measles cases in 2020 and 2021 compared to 2019, in Mweso, the average number of cases was higher during the first year of the COVID-19 pandemic than in the previous 3 years. At least two measles vaccination campaigns took place in April and October 2020 in Mweso health zone. [48, 49] This increase is of particular concern given measles' high mortality, especially among malnourished children, and the increased risk of other

infections due to related immunosuppression. [50] Global and severe acute malnutrition has been a public health concern in Mweso for years. While the last publicly available nutrition survey dates back to 2018 and reported alarming results (GAM prevalence 17.2% and SAM prevalence 10.3%), [51] more recent nutrition surveillance data reflect a fluctuating yet worrisome situation with GAM measured by mid-upper arm circumference (MUAC) between 12% in Q3 2020 [52] and 21% in Q1 2021. [53]

Interestingly, we saw several health services that reported an increase in consultations at the beginning of the pandemic. An increase was noted in outpatient consultations, ANC (both first and fourth visit), and institutional deliveries. These are likely unrelated to the COVID-19 pandemic, and could possibly be due to important population displacement that was recorded early 2020 due to the increase in violence and attacks on civilian population. [54] The increase in outpatient consultations seems unique to Mweso, as OPD decreased at the beginning of the pandemic both at national level [45, 46], in Kinshasa [44] and in other countries in the region. [55] Understanding the changes in maternal health services proved more challenging, either because of insufficient evidence or inconsistent results. Yet, increases in ANC, postnatal care and deliveries were observed also at the national level and in Kinshasa. [44–46] Consultations for infectious diseases did not appear to change at the beginning of the pandemic, although both consultations for malaria and for mild pneumonia showed an increasing trend during the study period. Increase in respiratory infections could reflect the increase in COVID-19 cases that affected North Kivu in June/July 2020. Yet, as COVID-19 testing data were not available by health zone, it is difficult to determine if these cases were misclassified as pneumonia. Malaria, which is endemic in North Kivu, remains one of the top three killers especially in rural areas where access to health care is limited.

While the study aimed to investigate fluctuations in health care utilization in Mweso in relation to the COVID-19 pandemic, the security situation is likely a major factor affecting utilization. Dozens of armed groups have been active in North Kivu alone for decades, fighting each other to establish control over territory and mines, killing civilians and extorting taxation. [56] Both the fear of violence and the economic burden of such roadblocks limit the population capacity to access farming land as well as health facilities. Health utilization rates may, therefore, show erratic or unexpected patterns as people access care during periods of relative calm, maintaining quite high coverage of schedulable interventions. [57] More problematic is accessing care for acute emergencies, as movements are limited.

Community members reported they continued to seek care during the first months of the COVID-19 pandemic, confirming our quantitative results. Health seeking behaviors did not seem to change at the beginning of the pandemic, as community member sought care for the same symptoms and in the same location as at the time of data collection. The main barrier in accessing health care was not COVID-19, but rather financial barriers. In DRC, households' funds (e.g., out-of-pocket expenditures) are the second largest source of health financing following external aid, and represent 40% of the total health expenditure. [58] Out-of-pocket expenditure represents more than 90% of household health expenditure, and are a particular burden for the poorest people in the community, who tend to forgo health care as it may be unaffordable. Health care is provided at no cost for children under the age of 5 years, and at health facilities that are supported by external technical and financial partners. However, as not all facilities are supported by external partners, health care remain inaccessible in many areas. Similarly to the Ebola outbreak in 2018 [59], free care policy was introduced during the 12th Ebola outbreak occurring in North

Kivu between February and May 2021, although it was effective only in Ebola facilities. [60] While free health care was shown to increase access to care [59], it was not introduced as part of the COVID-19 pandemic response, likely due to the spread of COVID-19 compared to Ebola. Until systemic barriers are not addressed and universal health care achieved, short term solutions will only temporally improve health access and outcome of DRC populations. [61]

At odds with our quantitative findings, HCWs perceived interruptions or decreases in service provision, especially for maternal and child health services as well as community outreach activities. The main reason for such decreases, however, was reported to be the absence or the departure of external technical and financial partners who were no longer supporting the health facility. This is a well-known constraint in Eastern DRC that results in a two-tiered system where health areas that are supported externally provide free and better services, and have drugs and medical equipment than health areas that are mostly government supported and rely primarily on out-of-pocket expenses. [57] Short term funding cycles and insufficient external aid (the 2020 and 2021 humanitarian appeals were funded at 40% and 44%, respectively [62]), as well as conflicting donor priorities contribute to fluctuating partner presence, and therefore interrupt health care availability for the population. Drug stock-outs were reported by both HCWs and community members. Challenges related to the procurement and availability of medicines have existed for a long time, and are reflected in the latest health facility assessment conducted in 2017, where the majority of health facilities had antibiotics for adults, but only one third had antibiotics for children or paracetamol. [63]

General COVID-19 related knowledge was high amongst the population surveyed, as was knowledge about infection mechanisms and protective factors. This seems to confirm that even remote communities received sufficient information via radio and community leaders at one and half year into the pandemic. Knowledge early on in the pandemic was much lower, both in North Kivu (other health zone) [64] as well as in other DRC provinces. [65, 66] Similarly to what was found in the CAR case study, as well as in other communities in North Kivu [64], the concept of asymptomatic case was not well understood. This remains critical to guide test seeking behavior in future pandemics. Specific messages to clarify this concept should be considered.

We also found a discrepancy between level of knowledge (high), reported practice of preventative measures (medium) and use of mask in recent social interactions (low). Although knowledge was found to be associated with higher odds of implementing preventative measures, it does not seem to be sufficient to guide preventative behaviors, and other incentives may be needed to ensure compliance with public health measures. Adherence to such measures was reported as higher at the beginning of the pandemic when the government imposed a mask mandate. Fear of fines and penalties was one of the main reasons why people wore masks in the early months of the pandemic. Mask adherence in African countries has been quite volatile with level of compliance ranging from 94% in Mozambique [67], 51% in Somalia [68], Sudan 46% [69], 41% to 69% in DRC [70], to 32% in Uganda. [68] However, these studies were web-based, possibly carrying a higher risk for social desirability bias. Other observational studies reported varying results, including 48% in Zambia [71] and 72% in Ghana. [72] Other studies conducted in DRC reported low face masks adherence, even among potentially at risk populations such as pregnant women. [73] Mask mandates seemed to be effective in other countries. [74] Yet, attitude towards the

government and trust in its capacity to respond to the pandemic may play a bigger role than mandates, therefore undermining potential effects of mandates. Lack of trust in the government has been found to be a factor influencing non-adherence to public health instructions in other DRC provinces [75], and it is likely even more relevant in eastern DRC where the relation with central authority has been tense for decades. The 2018-2020 Ebola response profoundly reduced the communities' trust in the authority [76], which had important consequences for the government capacity to respond to COVID-19 and highlighted the need for clear communication, community engagement and rumor management. In addition, economic barriers remain as households tend to prioritize basic needs (food) instead of preventative measures (masks). Understanding the barriers to mask wearing in a specific context is key to design appropriate interventions.

Hand washing, however, was reported to be highly practiced. Community members seem to attach more importance to this behavior as hand washing protects from multiple diseases such as cholera and other types of diarrhea. This may be due to previous exposure of WASH and health activities aimed to respond to multiple outbreaks such as Ebola and cholera in recent years, for which hand washing represents a key preventative measure. [77, 78] This is a positive finding that suggests that while behavior change does take time, it can be achieved. Yet, this finding may need to be further investigated as a similar evaluation of a nationwide community-driven WASH program in DRC did not find any association with improved COVID-19 related outcomes, including adherence to public measures. [79] Furthermore, while WASH interventions increased the availability of hand washing facilities during the COVID-19 pandemic in areas where community members did not have access to such devices before COVID-19, the majority of the respondents still remained without access to a functional hand washing facility with soap. The sustainability of such intervention is, unfortunately, challenged by the high cost of soap and water, which represents one of the main barriers to hand washing in eastern DRC. [64, 80]

Although our sample was not powered to identify difference among groups in different displacement status, and results should be considered as indicative only, respondents from IDP communities reported lower adherence to all preventative practices compared to residents. This is likely linked to high economic barriers, poor living conditions and overcrowding that make physical distancing very difficult. These challenges have been identified in other displacement settings in North Kivu [64], Somalia [81], and Syria. [82] IDPs in North Kivu advocated for long terms solutions, such as peace in the region, pointing to how they would be able to implement physical distancing if they were home. Short term solutions for some preventative measures include improving conditions in displacement sites such as providing individual family tents and soap. [64]

Acceptability of a COVID-19 vaccine if available was limited, with only half of the population reporting a positive attitude towards it, and 1 in 5 persons not willing to be vaccinated. Similar results have been found at national level early in the pandemic, [83] even among HCWs. [84] This low level of vaccine acceptance is worrisome, as it is not sufficient to prevent the spread of the disease and possible mutation of the virus. Vaccination activities started in DRC on April 19, 2021 against a backdrop of uncertainty, unclarity and mistrust. Key factors driving hesitancy included fear of side effects, low trust as it is the first vaccine against COVID-19 and it was quickly developed, lack of examples of uptake among leaders, and the perception that the Congolese population was used as laboratory test to study the vaccine despite

COVID-19 mainly being a “white people’s problem”. [85] The temporary suspension of ChAdOx1-S [recombinant] vaccine (the “Oxford/ AstraZeneca” vaccine) right when the campaign was supposed to start fueled further suspicion. [86] This situation resulted in very low vaccination coverage (2.8% of the total DRC population as of August 13, 22) [86] and hundreds of vaccine doses either wasted or sent back to COVAX or redirected towards neighboring countries where the uptake was higher. In North Kivu, mistrust of the new COVID-19 vaccine affected the trial of a second Ebola vaccine (being implemented early 2020), and reignited controversy about vaccine research, post-colonial exploitation, and the interests of Western pharma-capitalism. [85] Among IDPs in conflict affected areas, security and peace were perceived as the real priority, not the vaccine, as without the former the latter was considered to be pointless. [64] Yet, as trust in child routine vaccination is generally high, future approaches and interventions can contribute to increase trust also in the Ebola and COVID-19 vaccines. Misinformation both at local, national and international levels remains a key threat to successful public health policies. [87] Localized and adapted campaigns are needed to address context specific fears and rumors and to increase trust in communities. Examples of local leaders being vaccinated [88], engaging with religious groups in the co-development of messages and co-design of activities [89] promoting community level dialogues to clarify doubts and misinformation [90] represent promising approaches.

Regarding social interactions both before and during an outbreak, little evidence exists from LMICs about social dynamics and their implications for the spreading of infectious diseases. [91, 92] This was one of the constraints faced by modelling efforts early in the pandemic when available data to be inputted into models mainly originated from China and high-income countries, not reflecting the situation in LMICs. Even rarer is evidence from humanitarian settings. [93] A few social contact surveys have been conducted since the beginning of the pandemic, of which only four originate from non-high income countries [94], but none from humanitarian settings. Our case studies, including this one in DRC, therefore, increase the available evidence about social contacts in humanitarian and fragile contexts. Changes in behaviors at the beginning of the COVID-19 restrictions were reported regarding meeting duration (which were reported to be shorter) and frequency (less frequent or stopped completely). Furthermore, schools were closed, and religious events were either canceled or their size reduced, limiting the number of people who could attend. Yet, interrupting or reducing interactions was difficult as people had to continue working to sustain their families. Reduced interactions with elderly were also reported in an attempt to reduce their risk of infection.

A limited number of interactions were reported among the study participants compared to a recent study across several African countries. [95] In this study, the mean number of contacts in DRC was much higher (27 and 22 in August 2020 and February 2021, respectively). However, these two surveys were conducted via telephone, and therefore likely captured a population very different from the communities in Mweso. This result is, nevertheless, unexpected given that data were collected at a moment when government restrictions in population movement were not in place. Interactions were mainly with adults (average age 30 years), and the average number did not decrease with age. Average age of the contacts also did not differ dramatically among age groups, aligning with other studies showing that contacts are less assortative by age in LMICs. [91] Interactions were mainly at the respondent’s or the contact’s homes, especially among women, while meetings in public places such as markets, schools, places of worship or other places for leisure activities were rare. These results align with existing evidence from both LMICs

and African countries. [91, 95] Due to the delays with which data collection occurred, we were unable to estimate number and types of interactions during the first months of the COVID-19 pandemic. We, therefore, do not know whether the same low number of social contacts occurred early in the pandemic, which could contribute explaining the low number of reported COVID-19 cases. As more people reported being home early in the pandemic due to school closures, it is likely that more contacts did occur within the households. These findings have important implications for the effectiveness of preventative measures aiming to prevent infections. General mobility restrictions may be less effective in settings where the majority of the contacts occur at home.

6 Strengths and Limitations

Strengths

The main strength of this work relies on the investigation of communities' health needs and behaviors that are highly understudied due to the high level of insecurity characterizing the study site. Social contact and network surveys are extremely rare in humanitarian settings. Another strength was the systematic collection and analysis of COVID-19 line list data and health information systems data in such a setting. Therefore, this work contributes to the limited literature about humanitarian settings in general, and Eastern DRC in particular.

Limitations

Given the extensive effects that the COVID-19 pandemic has had on the entire society, this analysis remains partial as several other societal factors were not included, such as socio-economic consequences or short term and long term effects due to lack of schooling. Furthermore, the lack of information about comorbidities precluded the identification of non-demographic risk factors that could have contributed to the understanding of COVID-19.

Primary data collection was delayed due to a series of events, primarily ongoing conflict and insecurity in the study area, which led us to pause on launching data collection for several months. This was compounded by the May 2021 volcanic eruption at Mount Nyiragongo, which resulted in the evacuation of REACH staff and a need to support rapid response efforts following this event. As a result, data collection was conducted in November 2021, more than 18 months after the first COVID-19 outbreak was detected. This element should be taken into consideration when analyzing the results of this survey. Given the amount of time that elapsed since the first COVID-19 preventative measures had been imposed, respondents may have had difficulty recalling specific details regarding their attitudes and practices towards social interactions. Ongoing security issues in the study area resulted in restricted access to some parts of Mweso HZ (see figure 3). Additionally, some settlements were not accessible by vehicles. These issues had to be factored into selection of settlements during the first stage of the sampling strategy.

It was too challenging to organize FGDs according to migration status, as was initially planned. As such, FGDs were not organized per migration status, and no information on this indicator was collected from

FGD participants. However, a question was added to the quantitative questionnaire that asked respondents about their migration status.

Limited data on the numbers of IDPs, refugees, Consequently, stratified sampling per displacement status was not possible for household interviews. Therefore, findings presented and disaggregated per displacement status are not representative, and should be interpreted as indicative only.

7 Conclusions and Recommendations

1. Policies and their implementation

The DRC benefited from lessons learned from the multiple Ebola outbreaks in the country. Response measures were instituted including travel bans, widespread testing, quarantine, and community-based contact tracing. However, localized support was insufficient to address a disease that spread as quickly and widely as COVID-19 compared to Ebola. An after action review as to how best to integrate a pillar response structure into the provincial health systems for diseases according to their different characteristics, taking into account aspects such as the reduction of external support and funding due to the pandemic as well as insecurity in settings like North Kivu, should be undertaken.

The main barrier in accessing health care was reported by the community not to be COVID-19, but rather financial barriers. Health care provision and costs in the Kivus depend upon external technical and financial partners and their policies. While free health care for previous Ebola outbreaks was shown to increase access to care, it was not introduced as part of the COVID-19 pandemic response, likely due to the spread of COVID-19 compared to Ebola and the reduced external support. Until systemic barriers are addressed, and universal health care achieved, short term solutions will only temporally improve health access and outcome of DRC populations.
While the study aimed to investigate fluctuations in health care utilization in Mweso in relation to the COVID-19 pandemic, the security situation was likely a major factor affecting utilization and community outreach. Health utilization rates may, therefore, show erratic or unexpected patterns as people access care during periods of relative calm, maintaining quite high coverage of schedulable interventions. It was more problematic in accessing care for acute emergencies, as population movements were limited. Therefore, the initiation of disease-specific policies and their implementation in areas of conflict and insecurity need further reflection as to their direct and indirect consequences. Furthermore, interpretation of data must be made cautiously due to the complex interactions between responses due to disease prevention and control measures combined with insecurity.

2. Diseases testing capacity and strategies

Ensure testing capacity for COVID-19 and future diseases of epidemic potential is quickly scaled-up at the beginning of an epidemic in DRC to better understand the epidemiology of the disease.

If such rapid scale-up of testing is not possible, use a limited number of tests to undertake representative sample of tests to improve initial understanding of disease epidemiology and CFRs. For the latter, this may allay anxiety and encourage positive health seeking behavior if the population has a more realistic understanding of the mortality of the specific disease. It could also help build trust amongst the community and government authorities, which was noted as a barrier regarding understanding and positive health seeking behaviors.

As soon as feasible, undertake a population-based antibody serosurvey to improve the understanding of the epidemic and to allow for more informed policies and programs.

3. Health systems data management

Routine health services: Ensure continuity and transparency of reporting to avoid perceptions of service interruptions. Although the health systems data were not always consistent across the subregions, HCWs' perceptions that services were interrupted were not always supported by the health systems data. Real time contextual analysis of the data according to specific events in the health zones (e.g., implementation of specific policies such as isolation or quarantine, insecurity that could restrict people's movement) is needed to better interpret data. For example, the reported CFR was high (11%), and much higher than the estimated 2.6% CFR at the country level. While the CFR may be overestimated due to many cases going unreported, the increasing of cases coincided with the strike of HCWs involved in the response to COVID-19. In addition, oxygen capacity was limited and emergency services in remote areas of North Kivu were not easily accessible, increasing the risk of mortality for severe cases. Contextual analysis would help disentangle the various interacting elements and allow for improved interpretation of the situation.

COVID-19: Ensure clinical characteristics of cases are included in the line list to better understand epidemiology of the disease. Ensuring the line list is complete and up to date is also key.

4. Data from the community, and risk communication and community engagement

This study included a great deal of data from community members, including social interactions and knowledge, attitudes and practices. Numerous issues were documented, such as lack of trust amongst the community of authorities, and differences between knowledge and practice. Attitudes toward the government and trust in its capacity to respond to the pandemic may have played a larger role than mandates, possibly undermining potential effects of the latter. Data from the community showed mistrust of the new COVID-19 vaccine that affected the trial of an Ebola vaccine conducted early 2020, and reignited controversy about vaccine research, post-colonial exploitation, and the interests of Western pharma-capitalism. Some IDPs in North Kivu advocated for long terms solutions, such as peace in the region, pointing to how they would be able to implement physical distancing if they were home. Acknowledging to the community that while short term solutions for some preventative measures are needed now, the importance of longer term solutions, particularly peace and the return to their homes, is an important aspect that should not be ignored. In the future, community surveys

should be powered, if feasible, to disaggregate according to displacement status as their knowledge, attitudes and practices may be different than non-displaced persons.

Community members seem to have attached more importance to hand washing than masking and other preventative measures, possibly due to previous exposure of WASH and health activities aimed to respond to multiple outbreaks such as Ebola and cholera in recent years. This is a positive finding that suggests that while behavior change does take time, it can be achieved. Consequently, a sustained focus on specific issues (e.g., COVID-19 vaccine acceptance) should also include other diseases and measures already present in DRC (e.g., childhood vaccinations) that can also reduce the risk of conflicting messages.

Furthermore, more social interaction surveys in fragile and conflict-affected contexts need to be undertaken to support RCCE as well as service delivery in future epidemics. More studies are needed to examine the potential biases from telephone surveys compared with in-persons surveys.

The DRC has an 'Integrated Analytics Cell' (called CASS in DRC) that uses multidisciplinary and integrated analysis to better understand and respond to epidemics. Findings from this study can be used to inform, support and complement the work of this group, including the implementation of qualitative and quantitative methods from the community (including with a focus on HCWs) as well as 'data scraping' from the web and social media to understand communities' knowledge, attitudes and practices. As with health system data, community data need to be disaggregated according to the above-mentioned factors and repeated over time to understand trends. These data are essential to inform health service and RCCE strategies and services.

RCCE programs need to be adapted according to data and evidence collected. Data showed that knowledge about the disease and transmission pathway was high among adults in Mweso health zone; the concept of asymptomatic case and who is most at risk was, on the contrary, not well understood. Further investigation on the rural/ urban and displaced/ non-displaced divides is warranted to understand why this may be and how to correct it by trying to better target hard to reach populations. The concept of asymptomatic cases may require particular attention in RCCE messages. Finally, the success of the communication and awareness activities in RCCE is also dependent upon the need to address the structural and financial barriers as mentioned in the policy recommendations above.

5. Health care access and utilization

There is a need to improve the understanding of health care access and utilization during the COVID-19 epidemic in DRC. The ITS data showed an increase in overall OPD consultations and for maternal health services, with a decrease in childhood vaccinations. The reduction in measles vaccination was accompanied with an important increase in measles cases over the same period.

Further investigation into consultations for infectious diseases should occur to better understand health seeking behavior as results were inconclusive. The analysis must include qualitative and quantitative studies to better understand changes in health provision and quality of services as well as community perceptions. As mentioned above, the need for contextual analysis, including a political

economy analysis, will improve understanding and interpretation of the results. Such an analysis will allow for improved preventative and curative health service and RCCE programs during the current outbreak as well as for future epidemics.

6. Data triangulation

Our study shows the need to triangulate disease specific data, health systems data, and community-based data is essential for analysis and interpretation to inform strategies and programs. This is also an objective of CASS, mentioned above.

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9 Annexes