COVID-19 in Humanitarian and Fragile Contexts:

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

Central African Republic

Report prepared by the

Johns Hopkins Center for Humanitarian Health

In collaboration with Action Contre la Faim and IMPACT

Under USAID/BHA funding agreement no 720FDA20GR00228

December 2022

Shaping practices
Influencing policies
Impacting lives

Authors and study team members

Johns Hopkins Bloomberg School of Public Health, Center for Humanitarian Health

Chiara Altare, *PhD, MPH, MA, Asst Scientist*

Natalya Kostandova, *MPH, PhD Candidate*

Marissa Smith, *MSPH Candidate*

Paul Spiegel, *MD, MPH, Director; Professor of Practice*

Action contre la Faim

Gbètoho Fortuné Gankpe, *MD, MPH, MSc, Nutrition and Health Research Program Manager*

Sophie Bruneau, *MPH, Regional Health and Nutrition Advisor*

Caroline Antoine, *MPH, Health Advisor*

Abdul Azizi Almoustapha Abaradin, *Head of Health and Nutrition Department, CAR*

Patricia Nalimo, *Deputy Health and Nutrition Head of Department, CAR*

IMPACT

Head Quarter

Roxana Mullafiroze, *Manager*

Jasper Linke, *Manager*

Olivier Cecchi, *Manager*

Nayana Das, *Head of Research*

Katie Rickard, *Director*

CAR

Ugo Semat, *Country Director*

Melissa Pointet, *Research officer*

Sarah McArthur, *Research officer*

Samuel Carcanague, *Research officer*

Ana Tolosa, *Research officer*

Rodrigue Biguioh, *Research officer*

Acknowledgment

We would like to thank the USAID's Bureau of Humanitarian Assistance for funding this work.

We would like to thank all enumerators who made this study possible by collecting routine health data from monthly health facility reports as well as by interviewing community members and conducting focus group discussions. We thank the CAR Ministry of Health for granting access to the data.

Disclaimer

Table of Contents

List of Tables

List of Figures

Acronyms

ACF	Action Contre la Faim
ANC1	Antenatal Care First Visit
ARI	Acute Respiratory Infection
BCG	Bacille Calmette-Guerin vaccine
CAR	Central African Republic
CCCM	Camp Coordination and Camp Management
CI	Confidence Interval
COVID-19	Coronavirus Disease 2019
DRC	Democratic Republic of Congo
IDP	Internally Displaced People
F	Fisher test
FGD	Focus Group Discussion
HCWs	Health Care Workers
HD	Health District
HF	Health Facility
HH	Household
HIV/AIDS	Human Immunodeficiency Virus
HoH	Head of Household
HWF	Hand Washing Facility
IP	Institute Pasteur
IPC	Infection Prevention and Control
IRB	Institutional Review Board
IRR	Incidence Rate Ratio
ITS	Interrupted Time Series Analysis
KAP	Knowledge, Attitude and Practices
LMICs	Low- and middle-income countries
LNBCSP	*Laboratoire National de Biologie Clinique de Santé Publique*
NCDs	Non-CommunicableDdiseases
NGO	Non-Governmental Organization
OPD	Outpatient Department
OR	Odds Ratio
PCR	Polymerase Chain Reaction test
PPE	Personal Protective Equipment
RCCE	Risk Communication and Community Engagement
RTI	Respiratory Tract Infections
sd	Standard Deviation
TB	Tuberculosis
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

Executive Summary

Background and objectives

The COVID-19 pandemic broke out 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 the quite dire predictions did not occur. The objective of this study was to improve the understanding of the epidemiology of COVID-19 in the Central African Republic (CAR) and the 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. This study was part of a larger study implemented in three countries focusing on humanitarian settings: CAR, Democratic Republic of the Congo, and Bangladesh. 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.

CAR is a low-income sub-Saharan African country with a very young population. Decades of conflict have resulted in severe deterioration of the country's economy, infrastructure, and social networks, as conflict has occurred primarily along religious and ethnic lines. Half of the population requires humanitarian assistance. Health indicators in CAR are among the worst worldwide with among the highest maternal mortality, low vaccination coverage and infectious diseases representing the main cause of death.

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 providers, to provide a more comprehensive understanding of the situation in the research site during the first year of the COVID-19 pandemic. This case study includes four components:

1) A descriptive epidemiological analysis of reported COVID-19 cases in Bangui and surrounding areas, using national COVID-19 line lists;
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 health care workers followed by qualitative analysis using thematic and framework analysis; and
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

- Clinical presentation aligns with global epidemiology.
- Two COVID-19 line lists were managed by the Institute Pasteur and National laboratory, which differed overall and in terms of completeness. Testing was mainly targeting travelers, men and symptomatic cases, people resident in Bangui.
- Much lower COVID-19 prevalence than serosurvey results, which is to be expected.
- Higher incidence rate among elderly than younger population, which is expected.

2. Changes in health care utilization

- Outpatient consultations and consultations for respiratory tract infections (RTIs) showed a consistent immediate decrease within and across health districts. Yet, results are not statistically significant.
- Consultations for malaria reported inconsistent results, no clear trend identified.
- Maternal and reproductive health services reported a decrease in ANC1 and inconsistent results regarding deliveries and family planning.
- BCG vaccination showed an increase in most of the study districts; however, number of health facilities reporting is low. Results difficult to interpret.

3. Health care workers perceptions

- Violence and population displacement following presidential elections impacted the capacity to implement COVID-19 measures.
- Introduction of preventative measures due to COVID-19 led to the reorganization of health services including the installation of hand washing stations, introduction of temperature control at the facility entrance, establishment of isolation rooms, reduction of number of patients to ensure compliance with barrier measures, and introduction of new patient flow.
- Focus of attention, including financial resources, at health facilities, community outreach, training, etc. was shifted to COVID-19 at expense of other diseases and health topics.
- Human resources: Task shifting and termination of contracts due to lack of funding; HR shortages due to illness and delays in reporting to work.
- Reported drop in consultations (infectious diseases, NCDs, child health, vaccinations) and in laboratory tests (as linked to consultations) was reported by most respondents.
- Most frequently reported reasons for not going to health facilities: fear of being infected, fear of being tested, and increased waiting times.
- Reported drug stockouts due to border closure.
- Reduced income available at HF due to reduced consultations.

4. COVID-19 Knowledge, Health care seeking behaviors and social interactions

Knowledge and reported practice of preventative measure

- About half of the respondents are well or very well informed about who is most susceptible and about preventative measures. Yet, the concept of asymptomatic cases is not well understood.
- Knowledge and reported practice are high.
- Challenges to implementing protective measures include financial and practical barriers, personal (difficulty to breathe) and social (wearing a mask was negatively perceived).
- Lack of consultation was reported by community members who had wished to be involved in the decisions of introducing such measures.

Information sources

- Radio is main source of information, and it is also the most trusted source.
- Two rumors were circulating despite access to information:
  - The existence of COVID-19 was questioned, as it was perceived as a "white people disease" or a manipulation by the government.
  - Treatment and prevention measures were stated to include the bark of a tree, a local alcoholic drink, herbal tea, staying in the sun and praying.

Vaccination

- 3/4 of the respondents were willing to be vaccinated (probably or very probably).
- Respondents seemed to differentiate between routine child vaccines (which they trust) and COVID-19 vaccine (which they do not trust completely).
- Reasons for not trusting the COVID-19 vaccine include:
  - Race ("A disease the western want to share with us"; "This vaccine is for white people"; "Plot of the white man to kill black people").
  - Fear of secondary effects.
  - Rumors ("The vaccine will contaminate people"; sterility).

Health care seeking behavior

- Most of the respondents did not report experiencing an episode of illness during the first months of COVID-19 restrictions. Among those who did, the majority sought care.
- Most of the respondents who did not seek care reported this being due to financial barriers, especially among female headed households and displaced people.
- Fear of testing positive with COVID-19 and having to comply with related restrictions was a major deterrent to utilizing health care reported in FGDs. Other reasons included lack of medicine and of qualified personnel.
- Most of the respondents reported they vaccinated their children. This is consistent across age groups, sex, residence, displacement status. Interruption of services and fear of COVID-19 infection were the two most reported reasons among those respondents who did not vaccinate their children.

Access to WASH

- Half of the population has access to improved hand washing facilities at home, and some more in the community. One third of the respondents does not have access to hand washing facility, mainly due to lack of financial means as water and soap are too expensive.
- Most of the hand washing stations were not available before COVID-19.

Social interactions

- Changes in behaviors were reported during the first months of COVID-19 restrictions: frequency and duration of meetings decreased for most respondents, while a third mentioned that they stopped all meetings outside the households.
- Interactions were mainly with other adults, in homes, and outdoor. Most interactions lasted between 15 minutes and one hour.
- Masks were not worn.

Conclusion and Recommendations

1. **Policies and their implementation**

Policies addressing important aspects of access to COVID-19 testing and health care need to be considered and addressed, as feasible, for the current COVID-19 epidemic and future epidemics. For example, violence and population displacements following presidential elections likely affected access to health services as well the local capacity to implement COVID-19 measures that were being implemented at the country level. Financial barriers were important factors limiting COVID-19 testing and health care access. Furthermore, small health facilities with limited resources may have had less capacity to establish triage systems, hand washing stations and to enforce preventative measures, and health facilities located in different parts of town may have been affected differently. Task and resource shifting towards COVID-19 prevention and treatment activities was also reported in several health facilities. This led to the reduction in the provision of other services and increased waiting times. As in many other countries, health facilities struggled to maintain health service provision in CAR where HCWs fell sick with COVID-19. These are all signs of a low health system resilience where health facilities have limited adaptive capacity following a shock. We found few health program adaptations that were implemented to maintain health services. Rather external factors related to COVID-19 affected service provision with minimal capacity of health facilities to mitigate its impact. The fear of testing positive and having to comply with related restrictions, such as isolation and quarantine, as well as paying for such tests, were some of the main obstacles to seeking health care, and need to be addressed to ensure people will get tested and ultimately treated in health care facilities as appropriate.

The various policies and the variations of their implementation stated above show both the direct and indirect intended and unintended effects of the various policies implemented in CAR. They provide future direction when considering which policies to implement in different contexts and locales.

2. Diseases testing capacity and strategies

Results of the COVID-19 testing show that a higher number of men were tested than women, with a consequent higher incidence rate amongst men. This discrepancy could be due to more men traveling out of the country than women and a bias towards men having better access to COVID-19 testing than women. However, the number of tests were limited, and consequently, interpretation must be done cautiously.

In the future, CAR should ensure testing capacity for COVID-19 and future diseases of epidemic potential is quickly scaled-up at the beginning of an epidemic, as feasible, to better understand the epidemiology of the disease. Outreach to women should occur. Furthermore, a clear disaggregation and consequent analysis of the testing results should be undertaken, including differentiation by reason for getting tested (those being tested for travel, those with symptoms, contacts of positive cases, etc). If such rapid scale-up of testing is not possible or insufficient, a limited number of tests should be undertaken to have a representative sample of tests that will improve initial understanding of disease epidemiology and case fatality rates. 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.

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

There is a need to improve and standardize forms and methods of data collection before the epidemic occurs in CAR, e.g., contact tracing, testing, patient records, will allow for improved understanding of the epidemic and allow for more informed policies and programs. A focus on pre-existing health information systems as well as specifics systems for the disease of epidemic potential should occur to ensure that robust data are available for epidemic response as well as to ensure that existing health services are continued. Data should be disaggregated according to sex, age, displacement status, employment, location and travel, among other factors; other issues like ethnic and religious groups may be important as well, while ensuring data protection while considering political and cultural sensitivities. A simple and reliable data dashboard with trends over time is needed.

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

Knowledge about the disease, transmission pathway, and higher risk groups was high among adults in Bangui and its surroundings, which is in line with findings from a systematic review of KAP surveys from several African countries. One year into the pandemic, these results suggest that inhabitants of Bangui and its surroundings sufficiently accessed quality information. We were not able to include a sufficient sample of IDPs in our study. However, the qualitative results of the study show that the situation of IDPs in CAR is likely problematic; rural populations and IDPs were often less informed about COVID-19 related issues than urban populations and resident communities, although results were not statistically significant. This is an important area that needs more investigation and likely a concerted effort to ensure

that harder to reach populations, like IDPs and rural population, are actively targeted for specific RCCE messages.

There was an important discrepancy between knowledge (high), reported general practices (high) and specific implementation of a protective measure in a concrete encounter (very low). For example, masks were known to be one of the main preventative measures, and the majority of the population reported wearing them during the COVID-19 restriction months. However, masks were reported to be barely worn during meetings that happened the day before the survey. Multiple factors likely contributed to the limited use of masks, including financial barriers, social perceptions, peer pressure and personal discomfort. While mask mandates have been found to increase the chances of wearing a mask in other settings, some reticence in wearing masks or complying with governmental restrictions may also be related to the perception in our survey that measures were decided in a top-down manner, with no involvement of the communities. These factors point towards the importance of community engagement to increase awareness and trust in the epidemic response.

There is a need to implement 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.

Adaptation of RCCE programs according to data and evidence collected should occur. Data showed that knowledge about the disease, transmission pathway, and higher risk groups was high among adults in Bangui and its surroundings, but rural populations and IDPs were less informed about COVID-19. In the study context, radio and HCWs were reported as the most trusted information sources, therefore suggesting these channels through which communication should be provided. Given the quite high willingness to be vaccinated that was reported by the study population (also in line with other LMIC), especially among IDPs and rural populations, investments in communication campaigns to build upon this positive attitude would lead to higher return than in countries where hesitancy is higher. The overall positive attitude towards vaccinations could be leveraged by providing targeted information addressing side effects and other rumors.

A limited number of social contact surveys have been conducted since the beginning of the pandemic. In our survey, Interactions were mainly with adults and the average number did not decrease with age. Interactions were mainly at the respondent's or the contact's homes while meetings in public places such as restaurants or other places for leisure activities were rare. There were many positive aspects regarding COVID-19 among the communities in CAR. Positive changes in behavior were reported, limited number of persons attended religious events, and fewer interactions with persons outside of the family occurred. These, together with an overall positive attitude towards childhood vaccines and the COVID-19 vaccine in CAR appears to be higher than many other countries. This positive attitude should be built upon for other RCCE programs. Furthermore, ensuring there is sufficient supply of COVID-19 vaccines for all persons in CAR should occur.

5. Health care access and utilization

The study found a reduction in overall OPD health consultations, specifically for RTIs and for ANC. These were noted in qualitative interviews as well as observed in the quantitative data. The reduction in consultations for RTIs has been observed in several countries as well as in refugee settings in Jordan and Uganda. This is likely due to a variety of reasons, ranging from changes in health seeking behaviors due to difficulty to reach health facilities or fear of being infected; to an effective reduction in common RTIs thanks to COVID-19 related preventative measures such as masks, physical distancing, and school closures. The majority of respondents stated that they did bring their children for routine vaccination at the health centers, even during the first months of the pandemic. However, implementation of some vaccination campaigns were delayed possibly by COVID-19, but also due to lack of funding.

While the overall changes in the various health services utilized and how they altered over time may differ according to type of disease and geographic coverage due to a variety of factors, reductions did occur with varying degrees of restoration over time. These reductions in provision, access and utilization of health services represent an impediment towards universal coverage of essential interventions. Furthermore, their effects may be more serious amongst populations living in fragile and conflict-affected settings.

There is a need to Improve understanding of health care access and utilization during the epidemic considering the ITS data that showed a reduction in overall OPD health consultations, and specifically for RTIs and for ANC, as well as differences amongst urban and rural populations in CAR. Further investigation into delivery of childhood vaccinations as well as other health needs such as family planning, malaria and deliveries should occur to better understand what happened during the pandemic, and consequently inform programming. The analysis will include qualitative and quantitative studies to better understand changes in health provision and quality of services as well as community perceptions. This will allow for improved health service and RCCE programs in the current period as well as for future epidemics.

6. Data triangulation

Triangulation of disease specific data, health systems data, and community-based data is essential for analysis and interpretation to inform strategies and programs.

1 Introduction

The COVID-19 pandemic declared by the World Health Organization on March 20, 2020 has affected almost all countries in the world and all aspects of our societies. With more than 643 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 December 1, 2022 [7], with the majority of 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 noncommunicable 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 with 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; and
4. Document policies and interventions and investigate their impact on the epidemiology of COVID-19 and non-COVID-19 diseases.

The study was implemented in three countries focusing on humanitarian settings: Central African Republic (CAR), Democratic Republic of Congo (DRC), and Bangladesh. The study covered the first year of the COVID-19 pandemic (March 2020 to April 2021). More than 126.4 million cases and 2.8 million deaths were recorded globally by the end of the study period [14].

This report focuses on CAR 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 IMPACT, 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 health care workers (HCWs). IMPACT led the primary qualitative and quantitative data collection, by conducting focus group discussions and a household survey in the communities living in Bangui and surrounding areas.

2 Case study profile

CAR is a low-income sub-Saharan African country. As of 2021, its population was estimated at 4.9 million inhabitants over a land area of about 620,000 square kilometers. [15] The population is particularly young (average age was 20.1 years in 2021). [15]

Years of violence and insecurity since the country's independence in 1960 have resulted in severe deteriorations of the country's economy, infrastructure, and social networks, as conflict has occurred primarily along religious and ethnic lines. The latest crisis started in December 2012 with Seleka fighters launching an offensive against the CAR government that led to a coup in March 2013. During 2013 fighting intensified between Seleka fighters and "anti-balaka" forces causing thousands of deaths, extensive displacement both internally and to neighboring countries DRC and Cameroon. Violence continued and intensified despite elections in 2016. The government maintains control of the capital Bangui, but it has limited to no control in the remaining parts of the country where armed groups have grown and conflict has increased in 2018. A renewed increase in violence occurred in late 2020 due to parliamentary elections. The humanitarian situation has deteriorated since, and recent estimates indicate that almost 50% of the population has acute humanitarian needs. [16] Approximately 738,000 refugees from CAR are hosted in neighboring countries and about 650,000 are internally displaced persons (IDPs) as of April 2022. [17]

Health indicators in CAR are among the worst worldwide: maternal mortality rate was estimated at 829 deaths per 100,000 in 2017 and life expectancy at birth was 57 and 52 years in 2022 for women and men, respectively. [18] The most recent multi-indicator cluster survey (2019) [19] reported extremely low vaccination coverage estimates, ranging from 26% for Polio vaccine and 61.3% for BCG vaccine for Tuberculosis (TB). Coverage of measles vaccine was estimated at 45%. Stunting and wasting prevalence were estimated at 40% and 5.4%, respectively. Infectious diseases such as diarrhea, malaria and RTIs are prevalent, while access to health care and treatment limited. Estimating the burden of other diseases such as HIV or TB remain challenging given the lack of data. The latest HIV prevalence was estimated at 4.9% among the 15-49 year old in 2010. [20]

The research site (see fig 1) comprised five health districts in Bangui (Bangui 1, Bangui 2, Bangui 3), and surrounding areas (Bimbo and Bégoua) for a total population of 1,148,367 (see table 1). It included mainly urban and peri-urban areas; the majority of the population was non-displaced.

Table 1: Estimated population of the study area

Population group	Estimated population size
Bangui	930,763
Bimbo	185,093
Bégoua	32,511
Non-displaced	1,146,324
Displaced	2,043
Rural	101,044
Urban	1,047,323
All	**1,148,367**

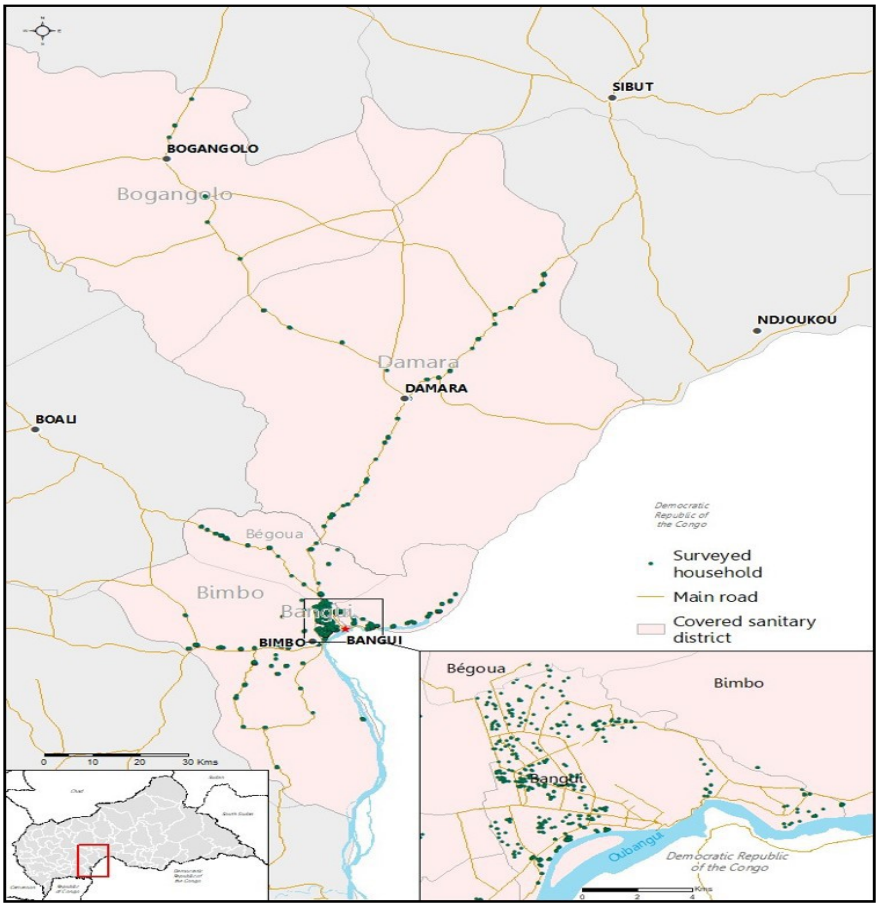

Figure 1: Map of the study area

2.1 COVID-19 response measures

CAR reported its first confirmed COVID-19 case on March 14, 2020. Within few days, the Ministry of Health and Population with support from partners including WHO and UNICEF developed the national Coronavirus Preparedness and Response Plan, which was endorsed by the CAR Government [21]. The plan included five pillars: Coordination and intersectoral coordination; Surveillance and laboratory; Infection Prevention and Control (IPC); Risk Communication and Community Engagement (RCCE), and Case Management.

The government's initial response was based on four priority actions: testing, quarantining, treating patients and tracking contact cases. On March 26, 2020, the government enacted new addition control measures with the goal of preventing and limiting local transmission. President Touadéra's addresses to the country included suspension of entry into the CAR, closures of schools, airports, and bars, isolation for confirmed cases, limitation of mourning ceremonies for marriages, doweries to strict family intimacy, local crisis committees in the provinces, and suspension of ceremonies and religious services. President Touadéra also announced restrictions of population movements between Bangui and the provinces to prevent the spread of infection from the capital to the provinces in the event of local transmission in Bangui [22].

According to the WHO, CAR was among the least prepared to face the pandemic. A country dealing with decades of armed conflict led to a state of unrest at the beginning of the pandemic. The lack of preparedness also came from high prevalence of infectious diseases such as malaria and HIV/AIDS. CAR has received considerable support in epidemiological surveillance but despite these efforts, performance in health care is less than adequate. The country's civil war has forced qualified health workers to flee violence prone areas leaving behind desolate and damaged health facilities. Primary health care is completely dependent on NGOs in the area and international charities - 70% of health services are provided by humanitarian organizations.

Since March 2020, the United Nations (UN) in CAR has been at the forefront of COVID-19 preparedness and response. The UN provided support for CAR during the beginning of the COVID-19 pandemic and the response has been planned and coordinated with technical partners including international, financial, and humanitarian community to ensure their programs were complementary and not repetitive between health and humanitarian responses. In April of 2020, the UN socio-economic response and recovery plan was put forth to plan for the next 18 months of support for immediate socio-economic interventions complementing humanitarian responses [23]. The plan is aligned with the United Nations Framework for the Immediate Socio-Economic Response for COVID-19 and is also embedded in the UN overall support for CAR's attainment of sustainable development goals.

Testing is a challenge in CAR. There are few test kits and even if there were more available, the country's laboratories' abilities to analyze tests is severely limited. With only two officially certified laboratories currently in place, the UN is contributing to the refurbishment and equipping of laboratories as well as the provision of COVID-19 testing kits. Given the limited testing capacity, the government diagnostic strategy limits tests to suspected cases and people at risk [24]. Building upon the surveillance capacity instituted in 2018 for Ebola prevention at international ports of entry such as Bangui M'poko International Airport, surveillance teams for COVID-19 have been established since early 2020 [21].

May 20th, 2021, the CAR government launched the COVID-19 vaccination campaign with the support of partners such as WHO, UNICEF, and GAVI. Beginning with the vaccination of members of the government and health workers, the campaign began the vaccination efforts for frontline health personnel, vulnerable people aged 50 and above, religious leaders, trader, community liaison volunteers, transporters, and journalists. The vaccination campaign covered 16 prefectures of the country but access to the whole country has been limited due to poor road conditions. In addition, 1 in 4 people in CAR are forced to walk over and hour to reach the nearest clinic making it difficult to receive medical attention or the vaccine [24].

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 providers, 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 health care workers (HCWs) on health service delivery adaptations, and
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 CAR's Ministry of Health and Population. Component 4 was deemed human subject research (IRB determination note 15447) as personal information was collected. Ethical approval from in-country IRB was obtained from the Ethic and scientific committee of the University of Bangui (IRB letter dated May 17, 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 CAR.

3.3.2 Data sources

In CAR, two laboratories with the capacity to test for COVID-19 at country level exist. The *Institute Pasteur* (IP) was the first to begin conducting RT-PCR testing (in March 2020) and two months later, the *Laboratoire National de Biologie Clinique de Santé Publique* (LNBCSP) started COVID-19 RT-PCR testing. These two laboratories kept distinct databases that were used for the analysis.

A COVID-19 line list was compiled by each laboratory and included all confirmed cases of COVID-19 between March 14, 2020 (for IP) and May 2020 (for LNBCS) and March 31, 2021. We considered the first

year of COVID-19 pandemic in CAR since the first case has been reported on March 14, 2020. The anonymized line lists included the following individual level information (although definitions differed between the two lists and completeness varied):

- Patient demographic information: age, sex, nationality, residence, address, district;
- Clinical presentation: date of first symptom, cough, fever, sore throat, dyspnea, chills, headache, loss of taste and smell, diarrhea;
- Information related to the test: dates of sample collection, test, results, whether patient was asymptomatic at sample collection, reason for being tested, site of sample collection (nasal or oropharyngeal);
- RT-PCR testing results: negative and positive in IP dataset; only positive in the LNBCSP dataset;
- Presence of comorbidities or other underlying conditions; and
- Exposure risks (travels, suspect contact with a confirmed case, country, local or imported case).

3.3.3 Analysis

We first assessed the completeness of each variable in the two databases. Due to an error in age attributed to individuals in the IP's data, we did not use the age variable from the IP dataset in the analysis.

We performed descriptive analysis to calculate the number of cumulative cases, testing rate, incidence ratio, age and gender distribution, clinical presentation. Statistical analysis was conducted in Stata software version 14. We considered population estimates for 2021 taken from United Nations Population prospects. [1] Quantitative variables were presented as mean ± standard deviation (sd) and 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 considered p-values less than 0.05 as statistically significant. Multivariate logistic regression was performed to determine the factors associated with the PCR results for the database from IP.

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

Routine health data originated from the national health information system. However, as the system is only partially digitalized, data on consultations for selected health services were extracted from paper based monthly health facility reports available at the district health offices within the study period (Jan 1, 2017- March 31, 2021).

We developed a data entry tool reflecting the format of the monthly activity reports of health facilities to facilitate data entry. Data collection was conducted on tablets using the KoboCollect data collection software. Access to the KoboTool Box database was password protected. Working sessions were held in

each health district with the heads of health facilities, hospitals, health districts and data managers on the subject of data collection, data availability and archiving of reports.

Eight interviewers with a bachelor's degree in social sciences and experience in tablet data collection were recruited and trained for three days prior to the survey. A pre-test was conducted to test the tools, collection conditions and use of the tablets. The interviewers were positioned in the health district offices where the monthly reports from the health centers were stored. Quality checks were performed by the survey coordinator on a daily basis and consisted of checking the completeness of the data, correcting errors, removing duplicates, ensuring consistency of information and accuracy of the data. Poorly completed questionnaires were returned to the enumerator the following day and mistakes were addressed. Once these checks were completed, data were uploaded to the server. Data collection lasted 3 months from April 1 to June 30, 2021. At the end of the data collection period, reports for some months of the study period were missing for some health facilities. Attempts were made to find these reports in the individual health facilities to complete the collection of data.

Electronic versions of the data existed and were obtained from the district health office for the limited number of months that they were available. In the health district of Bangui 1, we received electronic data from April 1 2020 to March 31, 2021. In the health district of Bangui2, electronic versions of the data were available from June 1, 2020 to March 31, 2021. There were no electronic data in the health district of Bangui 3. In the health district of Bégoua, we found electronic data for the year 2021 and the month of March 2021. In the health district of Bimbo, electronic versions of data for the year 2021 existed, but they were of poor quality. Consequently, data for 2021 was collected manually. All electronic data were reviewed for usability and format compatibility with our tools.

Collected data were then cleaned and prepared for analysis. Data extraction was coordinated by one of the authors (FG) with support of 2 ACF colleagues in country.

Data on the following outcomes of interest were collected: new outpatient consultations, first antenatal care (ANC1) visit, consultations for RTIs, hypertension, malaria, and BCG vaccination. Definitions of outcome indicators used in the analysis are presented in Table 2.

Table 2: List of indicators included in the interrupted time series analysis

Indicator name	Definition
Outpatient consultations	Number of outpatient consultations, monthly
ANC1 coverage	Number of first ANC consultations, monthly
Facility deliveries	Number of assisted deliveries performed in facility, monthly
Family planning consultations	Number of new and repeat consultations for family planning, monthly
Bacille Calmette-Guerin (BCG) vaccination	Number of children under 11 months of age who received the BCG vaccine dose
Respiratory tract infections	Number of consultations for RTI, monthly
Hypertension consultations	Number of consultations for hypertension, monthly
Malaria consultations	Total number of consultations for malaria (including severe and non-severe), monthly

3.4.3 Analysis

Health facilities were included in the analysis if they met all of the following requirements:

- At least 12 months of data prior to beginning of COVID-19 period;
- At least 3 months of data during COVID-19 period;
- At least 6 months of non-zero entries in pre-COVID period;
- Not missing all 12 months of data immediately preceding COVID-19 period; and

Outliers, defined as +/- 3 standard deviations from the mean value by indicator and for each health facility, were removed.

3.4.3.1 Interrupted Time series

To estimate changes at the beginning and during the COVID period we conducted interrupted time series (ITS) analysis by fitting following model to each facility:

$$y_{ij} = NB(y_{ij}|\mu_{ij}, \theta_i)$$

$$log(\mu_{ij}) = \alpha_{0i} + \alpha_{1i}s(month) + \beta_{1i}COVID_{period} + \beta_{2i}COVID_{month} + \beta_{3i}s(calendar\ month_i, cc, k = 3)$$

Where: y_{ij} is the number of consultations at health facility i in month j; NB denotes negative binomial function; α_{0i} is the facility-specific intercept; α_{1i} is the facility-specific coefficient for long-term trend; *month* is the variable for month of study, centered at beginning of COVID-19 period and smoothed; $COVID\_period$ is a variable taking value 0 in the pre-COVID-19 period (January 2019 – March 2020), and value of 1 in April 2020 onwards; *COVID_month* is the month since beginning of COVID-19 period; and $s(calendar\ month_i, cc, k = 3)$ is cubic splines with three knots to capture seasonality. For indicators where we did not expect marked seasonality, the $s(calendar\ month_i, cc, k = 3)$ term was dropped from the model.

For each of the five health districts (Bangui 1, Bangui 2, Bangui 3, Bégoua, and Bimbo), district-level estimates were obtained by pooling the facility-level estimates of β_1 and β_2 using inverse-variance meta-analysis approach. This means that results at district level are a weighted average of results at health facility level within each district. Random effect was assumed. Analysis was done using package *meta* [25].

For indicators with large volumes of consultations, such as outpatient consultations, total number of RTIs, and malaria, we replaced 0 values with 1 to facilitate model fit. If counterfactual for COVID-19 period included values that were at least 3 times those observed in pre-COVID period, we excluded that facility from analysis.

We report parameter estimates using the incidence rate ratio (IRR) and related 95% confidence interval (CI). For each outcome we present the level change at the beginning of the COVID-19 period, as well as the trend change for the COVID-19 period. We include a classification of the level of heterogeneity for each estimate. While acknowledging that each heterogeneity statistic is difficult to interpret on its own, we attempted to classify heterogeneity using I^2 statistic and p-value for the Chi^2 test for heterogeneity, roughly following the suggested interpretation in the Cochrane handbook.[26] Thus, if p-value <0.10, or I^2>50%, we classified this as having high evidence of heterogeneity ("high heterogeneity"). If 0.10≤p-value<0.20 40%<I^2≤50%, we classified this as "moderate heterogeneity"; and if I^2<40%, and p-value ≥0.20, we considered this as low evidence of heterogeneity ("low heterogeneity"). Standardized plots for each

facility were obtained by dividing the fitted values by the mean number of consultations for that health facility. Forest plots displaying facility-level estimates, as well as standardized plots, and measures of heterogeneity (τ^2, I^2, and Q statistics) are presented in *Supplementary materials*.

3.4.3.2 Difference from expected values

We calculate two measures of the difference with expected values: 1) the cumulative difference between observed and expected number of consultations (by type) over the study period; and 2) the average monthly percent change in consultations for each month of the COVID-19 period and at each facility within each health zone.

To do so, we first generated 1,000 predicted values ("expected") had there been no changes during the COVID-19 period using the base model, after setting the $COVID\_period$ and $COVID\_month$ terms to 0. If values less than 1 were generated, they were replaced with 1, as we expected at least one consultation at each health facility on a monthly basis. For months where observed data were missing, we imputed 1,000 possible observed values from the predicted mean and standard error from the base model. Difference between observed and expected values at each facility for each month was calculated for the 1,000 draws. For each of the draws, the cumulative difference between observed and expected values was calculated by summing up the difference from each of the health facilities in the health zone. From these 1,000 differences, median, 2.5th, and 97.5th quantiles were obtained. To calculate the average monthly percentage difference at health zone level, for each of the 1000 draws, for each month, we calculated the percent difference between cumulative observed and cumulative expected number of consultations for specific service. For each of the draws, we then obtained the average percent difference. The median, 2.5th, and 97.5th quantiles were then obtained for the average percent difference.

All analyses were conducted using R V.4.0.5, using package *mgcv.* [27]

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 health care providers about adaptations, measures, changes in consultations, as well as their understanding of population's perceptions.

3.5.2 Data sources

Respondents were selected among HCWs from the ACF supported health facilities in two of the five study districts. This was a purposive sample of HCWs aimed to include a variety of profiles from different health facilities. Following inclusion criteria guided the selection:

- At individual level:
    - Role/ position in the health facility;
    - Sex; and
    - Age.
- At health facility level:
    - Management type: public/ private / confessional;
    - Setting: rural or urban;
    - Population size covered by the health facility; and
    - Monthly number of consultations.

ACF supported 15 health facilities in two health districts (Bégoua and Bangui 2). Based on the above criteria, a total of 10 health facilities have been selected, four of which are from Bangui 2 health district and 6 from Bégoua; five are urban and five are in rural settings.

Twenty-six health workers were selected. We also included the five health district medical coordinators of each health district as they were involved in the COVID-19 response.

Qualitative interviews were conducted with the selected health care providers in their professional capacity between June 30 and July 15, 2021. An interview guide was developed for each profile (annex 1). We performed interviews in French or Sango (local language) depending on the participant's preference. Each interview was conducted by two trained interviewers. We used a voice recorder device when accepted by participant.

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. [28]

3.6 Health care seeking behavior and social interactions

3.6.1 Objectives

This component aimed to characterize social interactions; to explore knowledge, attitude and practices related to COVID-19; to improve understanding of health-seeking behavior, and how they evolved over time. More specifically, the study aimed to answer 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

Data collection took place between September 6 and 24, 2021.

3.6.2.1 Qualitative data collection

Qualitative data was collected via 24 semi-structured FGDs, with approximately six to eight participants for a total of 192 participants. The groups were stratified by sex, age group and vulnerability (see table 2 for details).

FGD participants were selected in consultation with community leaders, local authorities, and non-governmental organizations (NGOs) to ensure that participants were capable of providing precise and reliable information. To ensure a variety of opinions, key informants (for example local chiefs, community and religious leaders, leaders of women's and youth associations, camp representatives, merchants, or local authorities) as well as community members, participated in FGDs.

Six FGDs were conducted in each of the three targeted districts with men and women of two age groups (18-30 and 31-59 years). In addition, two FGDs in each district were comprised of vulnerable persons: either those over the age of 60 years or those considered vulnerable by their community (e.g., those living with chronic illnesses, physically disabled, or pregnant and nursing women).[1] The locations of FGDs varied: six FGDs were in displacement camps, six in rural zones and 12 in urban zones. FGDs lasted on average 150 minutes. A guide for the FGD was developed in French (annex 2).

[1] The FGDs with vulnerable persons were mixed gender, with the exception of the FGD of pregnant and nursing women. These FGDs used a slightly adapted questionnaire.

Table 3: Characteristics of focus group discussions' participants

Health District	Area Type	Sex	Age (yr) / Category	Status	# FGD participants
Bégoua	Urban	Female	31-59	non-displaced	7
Bégoua	Urban	Male	18-30, 31-59	non-displaced	8
Bégoua	Rural	Mixed	60+	non-displaced	8
Bégoua	Rural	Male	31-59	non-displaced	10
Bégoua	Urban	Female	31-59	non-displaced	7
Bégoua	Urban	Female	18-31, Pregnant, nursing Female	non-displaced	7
Bégoua	Rural	Male	31-59	non-displaced	10
Bégoua	Rural	Female	31-59	non-displaced	8
Bimbo	Rural	Male	18-30	non-displaced	9
Bimbo	Rural	Female	31-59	non-displaced	8
Bimbo	Urban	Male	18-30	IDPs (site)	8
Bimbo	Urban	Female	31-59	IDPs (site)	9
Bimbo	Urban	Male	31-59	non-displaced	8
Bimbo	Urban	Female	18-30	non-displaced	9
Bimbo	Urban	Mixed	60+	non-displaced	6
Bimbo	Urban	Mixed	Vulnerable	non-displaced	4
Bimbo	Urban	Female	31-59	IDPs (site)	8
Bangui	Urban	Female	18-30	IDPs (site)	8
Bangui	Urban	Mixed	60+	IDPs (site)	9
Bangui	Urban	Male	31-59	IDPs (site)	9
Bangui	Urban	Male	31-59	non-displaced	8
Bangui	Urban	Male	18-30	non-displaced	8
Bangui	Urban	Mixed	Vulnerable	non-displaced	8
Bangui	Urban	Female	18-30	non-displaced	8

3.6.2.2 Quantitative data collection

Sampling was carried out on two levels. The first level was represented by localities (districts and villages): the number of households to survey in each locality was identified with a probability proportional to the population size of the locality. Secondly, individual households within each locality were selected via random allocation of a GPS point per household. Sampling was stratified by location (rural or urban) and displacement status. Sample size was calculated for a +/- 5% margin of error at a 95% confidence level.

Population data created by Facebook and the Center for International Earth Science Information Network from April 2018,[2] supplemented by census data of displacement camps conducted by the Camp Coordination and Camp Management (CCCM) Cluster (some of them checked and updated by REACH before data collection) were used to inform this sampling process.

Final sample size for the household survey comprised 1,045 households. See table 3 for details of the surveyed population.

[2] HDX, FACEBOOK – *Central African Republic: High Resolution Population Density Maps + Demographic Estimates*, updated in April 2018.

Table 4: Surveyed population by age, district, population displacement status, Central African Republic 2021.

	Bangui			Bégoua		Bimbo				Total
	Urban			Rural	Urban	Rural	Urban			
	IDP	Res	Total	Res	Res	Res	IDP	Res	Tot	
18-29	**29**	**89**	**118**	**34**		**67**	**18**	**34**	**52**	**271**
Female	28	64	92	24		50	15	27	42	208
Male	1	25	26	10		17	3	7	10	63
30-59	**77**	**218**	**295**	**99**	**2**	**149**	**54**	**63**	**117**	**662**
Female	41	129	170	53	1	83	26	41	67	374
Male	36	89	125	46	1	66	28	22	50	288
60+	**3**	**40**	**43**	**10**		**34**	**9**	**16**	**25**	**112**
Female	1	22	23	4		13	6	8	14	54
Male	2	18	20	6		21	3	8	11	58
Grand Total	**109**	**347**	**456**	**143**	**2**	**250**	**81**	**113**	**194**	**1045**

The interview guide was developed in French (annex 3). Data was collected on tablets with ODK technology.

3.6.3 Analysis

3.6.3.1 Qualitative analysis

Qualitative data was analyzed using a saturation matrix. This process involves the listing of all of the discussion points raised for each research question during all of the FGDs. The number of mentions of each discussion point is counted to identify the most common opinions expressed and information provided by group members.

3.6.3.2 Quantitative analysis

We conducted a weighted analysis of survey responses, disaggregated by category of respondent. The categories for disaggregation are: age group (18-29, 30-59, or over 60 years old), sex (female or male), displacement status (resident or IDP) and health district (Bangui, Bimbo or Bégoua), and location (urban or rural). Descriptive statistics (frequencies, means, proportions) were calculated; associations with selected outcomes were estimated using logistic regression.

We also investigated level of knowledge about COVID-19 at the time of data collection, using three multiple choice questions (table 5). An aggregated score was calculated as the average of the question specific scores and respondents classified as not / partially / informed or well informed.

Table 5: Classification of respondents by knowledge related to key characteristics of COVID-19

Question	Score	Options
In your opinion, who is the most susceptible to falling seriously ill due to Coronavirus?	«Bien informé» (well informed) corresponds to those who selected the 4 correct options	Everyone Elderly people (60+ years) Adults (19-59 years) People with pre-existing conditions (respiratory problems, heart problems, etc)
	«Informé» (informed) corresponds to those who selected 3 out of 4 correct options.	
	«Un peu informé» (a little informed) corresponds to those who selected 1 of these options.	Everyone Elderly people (60+ years) Adults (19-59 years) Children (0-18 years) People with pre-existing conditions (respiratory problems, heart problems, etc) Health workers
	«Pas du tout informé» (not at all informed) corresponds to those who selected other options.	Pregnant or nursing women Do not know / prefer not to respond
How can a person contract COVID-19?	«Bien informé» (well informed) corresponds to those who selected all 3 correct options.	Via particles in the air (when others cough / sneeze) Via physical contact with infected people Via physical contact with a contaminated object or surface
	«Informé» (informed) corresponds to those who selected 2 out of 3 correct options.	
	«Un peu informé» (a little informed) corresponds to those who selected 1 out of 3 correct options	
	«Pas du tout informé» (not at all informed) corresponds to those who chose only among these other options.	By drinking contaminated water By washing in contaminated water By eating certain foods Contaminated breastmilk / breastfeeding Other Do not know / prefer not to respond
In your opinion, is it possible to take measures to reduce the risk of contracting COVID-19? If yes, how do you reduce the risk of contracting COVID-19?	«Bien informé» (well informed) corresponds to those who selected the 6 answers which refer to « preventative measures »	Reduce contact with others by avoiding crowds, staying at home, etc Increase the distance between oneself and others Stop shaking hands or hugging Wear a mask / face covering Hand washing Disinfect and/or clean objects and surfaces
	«Informé» (Informed) corresponds to those who selected 5 out of 6 answers	

	«Un peu informé» (a little informed) corresponds to those who selected 4 out of these 7 options	Reduce contact with others by avoiding crowds, staying at home, etc Increase the distance between oneself and others Stop shaking hands or hugging Wear a mask / face covering Hand washing Disinfect and/or clean objects and surfaces Wear gloves (even though literature was clear on the use of gloves, at the time it was not at all clear for the general public).
	«Pas du tout informé» (not at all informed) corresponds to those who selected any of these options	Other Do not know / prefer not to respond Praying

Responses are representative at household level, with 5% margin of error and 95% CI. The margin of error is wider for disaggregated results (for IDP) due to undersampling of the specific groups (IDP). The disaggregation is based on age and sex is less accurate because these categories were not part of the stratification of the sample.

The software used for this analysis was R 3.6.0 (2019-04-26), in particular the "hypegrammaR", "koboquest" and "surveyweights" packages.

4 Case study findings

4.1 COVID-19 epidemiology

4.1.1 Key results

- Variables in the two datasets from Pasteur and National laboratory differ overall and in terms of completeness.
- Sex difference in testing and cases is noted, with many more men than women being tested and resulting positive.
- Pasteur dataset has more people tested in Bangui.
- The two combined data sets have an epidemiological curve that is consistent with WHO reported data, which implies data sets have limited overlap.
- Much lower COVID-19 prevalence than serosurvey results, which is to be expected.
- Higher incidence rate among elderly than younger population, which is expected.
- First wave:
    - Testing capacity increased for 4-5 months.
    - Then lower number of tests reflected in increased positivity rate → many cases likely missed.
    - Symptomatic people and travelers more likely to test positive.
- Testing capacity (only with Pasteur data)
    - Likely skewed towards foreigners, travelers, and symptomatic people.
- Clinical presentation aligns with global epidemiology.

4.1.2 Description of the data

4.1.2.1 The datasets

The two datasets are anonymized and used different IDs. We tried to match cases between the two datasets, but it was not possible to recognize whether the same case had been included in both line list.

The Institute Pasteur line list included all those who have been tested with both positive, negative or invalid test results while the **National Laboratory** line list includes only confirmed COVID-19 cases (i.e., persons with a positive test result; see table 6).

Table 6: Overview of COVID-19 datasets from Institute Pasteur and National Laboratory

	Pasteur	National Laboratory
N	25,188	3,340
Positive test	3,992 (15.9%)	3,339 (99.97%)
Negative test	21,057 (83.7%)	NA
Invalid	125 (0.5%)	1 (0.03%)

4.1.2.2 Completeness by variable

Variables included in the two-line lists are different, with some overlap (see table 7). There were 25,187 and 3,340 observations in the database of the Institute Pasteur and the National Laboratory, respectively.

Age and sex were available for almost entries (>94.9%). There was very little information concerning the health district, health region, or facility. Data of the clinical presentation of confirmed cases of COVID-19 were better recorded in the Pasteur database (up to 94%), than the National Laboratory (19%). The date variable was empty in National Laboratory except the date of sample collection and date of PCR SARS-CoV 2 result for which 100% of information were recorded. No information about clinical management and disease outcome was recorded in any of the datasets.

Both line lists included a "Comments" field that captured details about travel, origin and comorbidity, hypertension, and diabetes. These were used to define the following two variables: i) “Travel” (Yes / No) meaning a patient who had been travelling (no details about timing or destination available); and ii) “origin” i.e., the country or city where patient come from.

Table 7: Completeness by variable in COVID-19 dataset in CAR

Variable	Institute Pasteur	National Laboratory
N of cases included in each data set	25,187	3,340
Unique Code		100%
Health region		0.8%
Health district		0.83%
Facility		0.23%
Origin		99.43%
Address	99.72%	
Sex	99.64%	98.74%
Age	95.68%	94.88%
Entry number		100%
Provider		89.28%
Phone		0.45%
Nationality		0.89%
Date of symptoms onset	6.39%	0.02%
Symptomatic		19.13%
Temperature	77.03%	10.47%
Headache	94.93%	19.13%
Short breath	93.66%	19.13%
Cough	94.79%	19.13%
Sore throat	94.22%	19.13%
Chills	93.97%	19.13%
Ageusia	92.91%	19.16%
Anosmia	92.92%	19.13%
Ageusia/anosmia		
Diarrhea		19.13%
Comorbidity	0.48%	
Date of sample collection	99,88%	100%
Reception date of sample	23.89%	
Time between COVID-19 test and result	1.30%	
Result of PCR SARS COV-2	99.95%	
Date of PCR	99.94%	
Comments	99.97%	45.71%
Influenza/ others respiratory virus	0.56%	

Case contact	NA	
Initial sample/no	33.44%	99.16%
Suspect cases		19.13%
Urgent cases		19.13%
Postmortem cases		19.13%
Travel		42.21%
Confirmed case contact		19.13%
International trip		19.13%
Others		0.30%
Control		99.16%
Country		0.02%
Local or imported cases		96.46%
Arrive date in CAR	21.74%	5.32%
Date of last contact with confirmed case		5.95%
Site of sample		100%
N GENE		100%
Ct1		94.37%
DATE1		100%
ORF1ab		100%
CT2		97.24%
DATE2		100%
CONCLUSION		45.71%

4.1.3 Distribution by sex, age, residence/origin

Table 8: Distribution of population by age, sex, residence in the two datasets

	National laboratory	Pasteur Institute	
	Cases (Positive only)	All results (positive + negative)	Cases (Positive only)
Total	3,339	25,049	3,992
Sex			
Female	916 (27.8%)	6,398 (25.5%)	1,037 (26.1%)
Male	2382 (72.2%)	18,688 (74.5%)	2,941 (73.9%)
Age	37.7 ±13.7 [1, 131]	NA	NA
0 - 4	35 (1.1%)		
5 – 11	80 (2.5%)		
12 – 17	81 (2.6%)		
18 - 29	615 (19.4%)		
30 – 39	1023 (32.3%)		
40 – 49	757 (23.9%)		
50 – 59	387 (12.2%)		
60+	191 (6.0%)		
Residence			
Bangui	2,692 (81.2%)	13,522 (58.3%)	2,458 (66.2%)
Bimbo	13 (0.4%)	1,177 (5.1%)	244 (6.6%)
Bégoua	211 (6.4%)	1,052 (4.5%)	133 (3.6%)
Other cities	391 (11.8%)	4,520 (19.5%)	427 (11.5%)
Other countries	9 (0.3%)	2,922 (12.6%)	451 (12.1%)

4.1.4 Epi curve based on date of sample collection

Figure 3 shows the epidemiological curve of infections based on weekly confirmed cases at the country level. The two trend curves representing the data from the two laboratories are superimposed. The majority of confirmed COVID-19 cases occurred in June and July 2020.

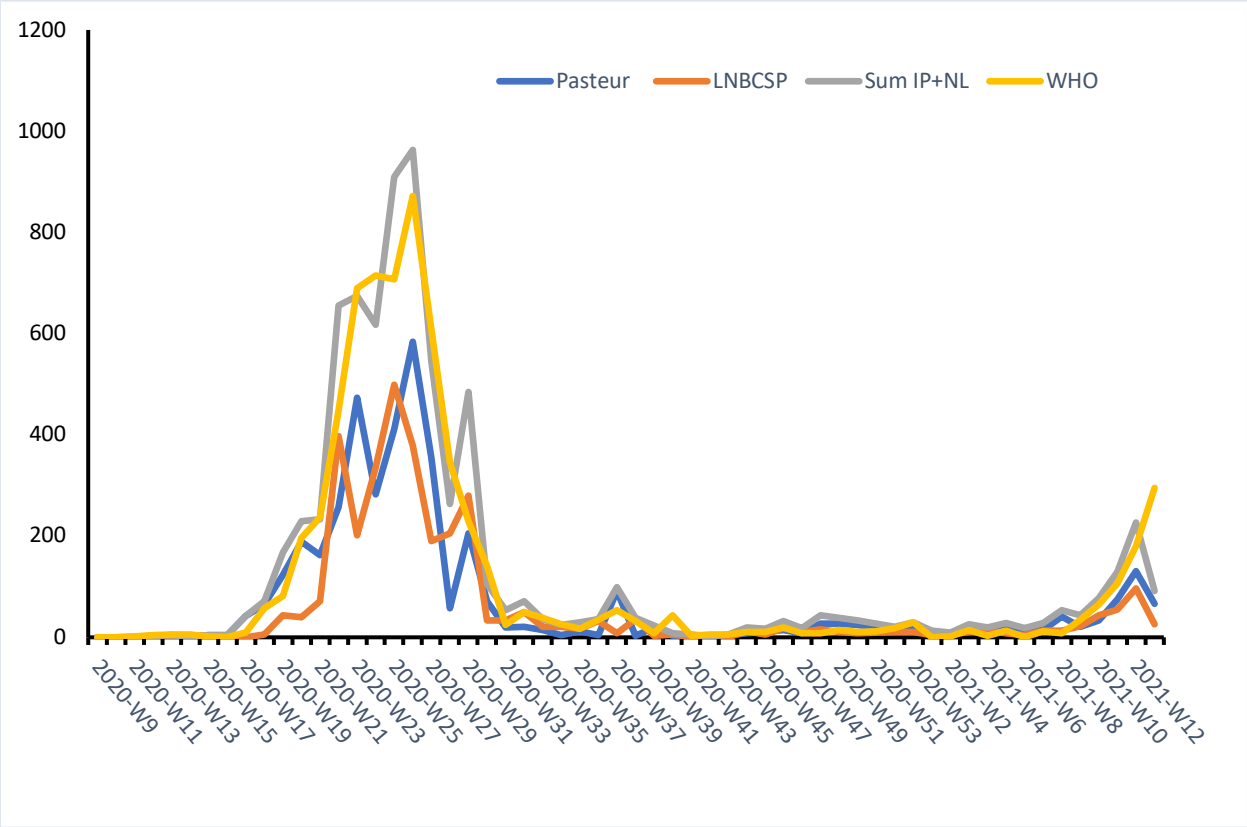

Figure 2: Epidemiological curve of COVID-19 Cases in CAR from March 14, 2020 to March 31, 2021

[Data from: Institute Pasteur; National Laboratory; WHO (https://covid19.who.int/data)]

4.1.5 Incidence rates

Table 9 shows incidence rates per 100,000 populations according to the two datasets. Incidence rates for different age groups were calculated using the LNBCSP. It was 81.1 per 100,000 in Institut Pasteur and 68.9 per 100,000 in LNBCSP. The incidence rate was higher in the elderly group.

Table 9: Incidence rate in the total population and by age group, COVID-19 cases data from Institute Pasteur and Laboratoire Nationale, March 1, 2020 to March 31, 2021, Central African Republic.

	Institut Pasteur	LNBCSP

	Total population	Total population	0-19	20-59	60+
Cases (n)	3,992	3,339	196	2,782	191
Population	4,920,000	4,920,000	2,727,000	1,970,000	222,000
IR (per 100,000)	81.14	68.9	8.91	138.78	86.04
95% CI	81.13 – 81.15	66.58 – 71.22	7.79 – 10.03	133.58 - 143.98	78.83 – 98.23

Source of population estimate: [15]

4.1.6 Testing capacity

While the line list of the national laboratory included only cases (i.e., patients with a positive test results), the line list from Pasteur Institute also included people who received a negative result. This distinction allowed us to calculate the testing rate and the positivity rate (table 10).

Note: this certainly underestimates testing capacity as test conducted by LNBCSP are not included.

Table 10: COVID-19 testing capacity for the study period from March 1, 2020 to March 31, 2021 (Pasteur Institute data only)

	Testing capacity Pasteur Institute data
Population	4,920,000
Tests	25,188
Testing rate per 100,000	511.9
Confirmed cases	3,992
Test per case ratio	6.3
Undetermined cases	125 (0.50%)
Positivity rate	15.9%

Table 11 shows the number of tests over time for the one-year study period since the first case of COVID-19 was declared in CAR, the testing rate per 100,000 population, and the positivity rate.

Curves of testing and incidence rates (figure 4) followed similar trends. The number of conducted tests and positive cases increased progressively with a peak in May-June 2020 corresponding to the first wave of COVID-19 outbreak in CAR (figure 4).

Table 11: Testing capacity for COVID-19 over time based on Pasteur Institute data from March 2020 to March 2021

Months	Number of tests	Testing rate per 100,000	Confirmed cases	Incidence rate (100,000 people)	Positivity rate (%)
March 2020	75	1.54	8	0.16	10.7
April 2020	3,526	72.49	88	1.79	2.5
May 2020	8,592	176.65	756	15.36	8.8
June 2020	7,169	147.39	1936	39.35	27.0
July 2020	2,175	44.72	403	8.19	18.5
August 2020	1,230	25.29	54	1.10	4.4
September 2020	602	12.38	118	2.40	19.6
October 2020	253	5.20	19	0.39	7.5
November 2020	214	4.40	64	1.30	29.9
December 2020	341	7.01	93	1.89	27.3
January 2021	71	1.46	34	0.69	47.9
February 2021	143	2.94	90	1.83	62.9
March 2021	761	15.65	326	6.63	42.8
Total	**25,152**	**511.2**	**3,989**	**81.08**	**15.9**

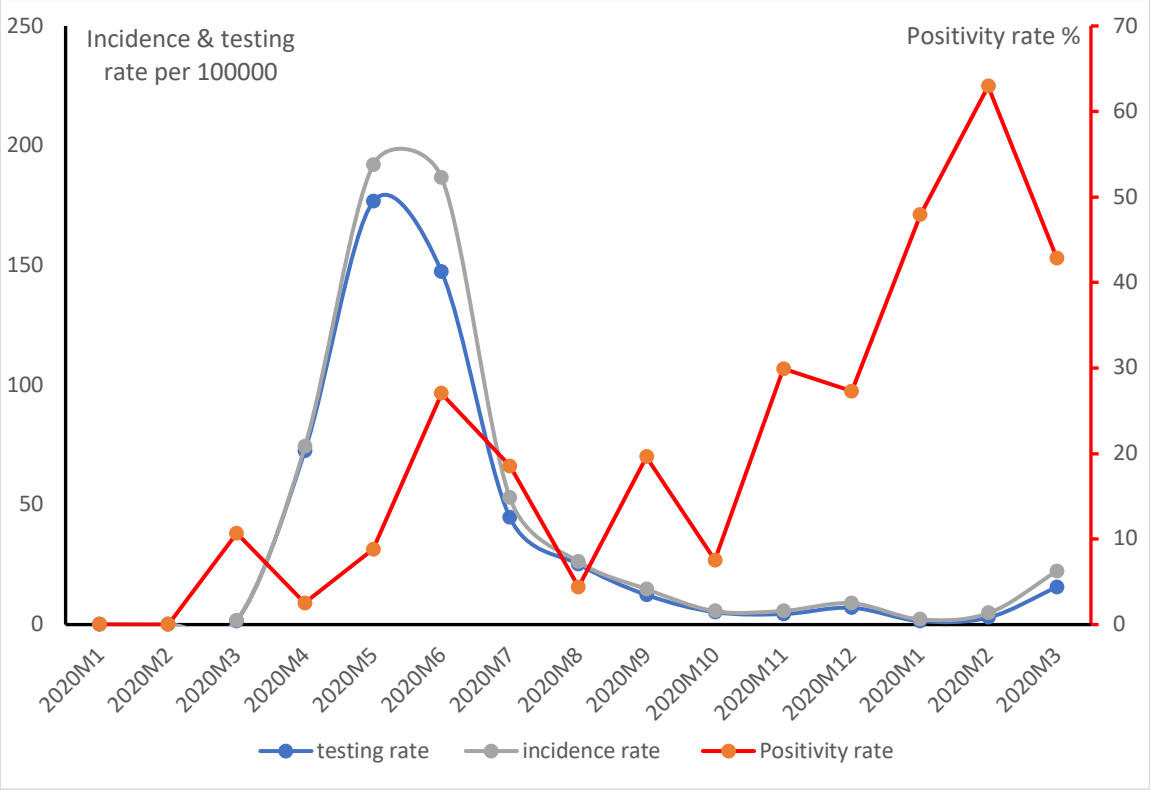

Figure 3: Trend of testing rate, incidence rate per 100,000 population and positivity rate per 100 population of confirmed cases over time (Data from Insititut Pasteur)

No variable was included in the Institut Pasteur's dataset to track the reasons for being tested; however, details were available in the comment field for 66.5 % of the cases. The two main reasons for being tested were either being a contact of a case, or due to travel (since all travelers must be tested for COVID-19 upon entering and leaving the country until March 31, 2021). 7,637 people (30.3%) underwent a COVID-19 test because they had to exit or enter the country (table 12).

Table 12: Distribution of test results by reason for being tested (Pasteur database).

	PCR test conducted				p-value
	Negative	Invalid	Positive	Total	
N	21,057	125	3,922	25,188	
Travel (N= 12,132)					
Yes	6,776 (88.7%)	3 (0.0%)	858 (11.2%)	7,637 (100%)	p< 0.0001
No	3,434 (76.4%)	116 (2.58%)	945 (21.0%)	4,495 (100%)	
Being a contact (N=3,875)					p< 0.0001
Yes	3,040 (78.5%)	106 (2.7%)	729 (18.8%)	3,875 (100%)	
No	18,014 (84.6%)	19 (0.1%)	3,262 (15.3%)	21,295 (100%)	

4.1.7 Description of symptoms

Different symptoms were recognized as the clinical presentation of the infection of COVID-19, including fever, cough, chills, dyspnea, ageusia, anosmia. Information about symptoms was available for 3,975 (i.e 99.5% of total cases in the Pasteur dataset (table 13) and for 639 cases (19.1%) in the LNBCSP dataset (table 14).

Table 13: COVID-19 cases clinical presentation by sex (Pasteur database)

	Sex		
	Female	Male	p
N	1,037 (26.1%)	2,938 (73.9%)	
Fever	453 (11.4%)	1,108 (27.8%)	p=0.001
Cough	187 (5.1%)	463 (12.57%)	p<=0.06
Chills	80 (2.2%)	138 (3.8%)	p< 0.0001
Dyspnea	57 (1.6%)	218 (6%)	P=0.05
Loss of taste	58 (1.7%)	91 (2.7%)	p< 0.0001
Loss of smell	43 (1.3%)	82 (2.4%)	P=0.01
Sore throat	94 (2.6%)	179 (4.9%)	p=0.001
Overall (symptomatic)	**257 (6.5%)**	**787 (19.8%)**	**p=0.2**

Percentages are row-wide.

In LNBCSP population, the main age groups who manifested COVID-19 symptoms were young adults from 18 to 59 years old.

Table 14: COVID-19 cases clinical presentation by age and sex (LNBCSP database)

	Age				Sex		
	0 – 17	18 – 59	>60	p	Female	Male	p
Fever	190 (6.7%)	2,501 (87.7%)	162 (5.7%)	p< 0.0001	804 (27.1%)	2163 (72.9%)	p=0.009
Cough	4 (2.5%)	137 (87.3%)	16 (10.2%)	p=0.56	60 (35.5%)	109 (64.5%)	P= 0.313
Chills	4 (4.1%)	84 (85.7%)	10 (10.2%)	p=0.92	36 (34.6%)	68 (65.4%)	P= 0.596
Dyspnea	2 (2.3%)	75 (85.2%)	11 (12.5%)	p=0.38	26 (28.3%)	66 (71.7%)	P=0.360
Loss of taste	1 (5%)	17 (85%)	2 (10%)	p=0.95	9 (45%)	11 (55%)	P= 0.221
Loss of smell	0 (0%)	10 (83.3%)	2 (16.7%)	p=0.54	4 (30.8%)	9 (69.2%)	P=0.582
Sore throat	2 (2.4%)	76 (91.6%)	5 (6.0%)	p=0.40	35 (38.9%)	55 (61.1%)	p=0.155
Overall (symptomatic)	**10 (2.5%)**	**340 (87.0%)**	**41 (10.5%)**	**p=0.03**	**127 (30.4%)**	**291 (69.6%)**	**P=0.134**

4.1.8 Time between symptoms and test and results

Information in Pasteur dataset allowed us to calculate the delay between COVID-19 test and symptoms onset averaged 6.2 days ranging from zero to seven days. The delay of COVID-19 PCR test results (between sample collection and PCR results) was an average of 3.08 days range from zero to two months.

4.1.9 Risk factors associated with positive test results

Table 15 shows the results from the multivariate logistic regression estimating factors associated with a positive test result. Only data from the Institute Pasteur could be used for this analysis. Regarding the model fit, the variables in the multivariate model are jointly significant (p=0.000) and explain 4% of the variance in the variable PCR (PCR test result).

Males were significantly more likely than females to test positive. Being a foreign resident in CAR increased the probability of testing positive for COVID-19 compared to residents of Bangui (OR=2.52; p=0.000). In contrast, residents of Bégoua, had significantly lower odds than Bangui residents (OR=0.66; p=0.007) for a positive COVID-19 PCR test. People with symptoms had higher odds than people without symptoms to test positive. However, people traveling did not have higher odds of testing positive than people who were not travelling.

Table 15: Adjusted odds ratio for multiple risk factors for confirmed COVID-19 cases

Risk factors for positive test results	Odds Ratio	p	95% CI
Male (Ref: female)	1.14	0.049	1.0 – 1.3
Residence (Ref: Bangui)			
Bimbo	1.17	0.19	0.92 – 1.48
Bégoua	0.66	0.007	0.48 – 0.89
Other cities	1.02	0.76	0.87 – 1.21
Other countries	2.52	<0.0001	2.15 – 2.94
Symptomatic (Ref: No symptom)	1.57	<0.0001	1.36 – 1.81
Travel (Ref: no travel)	0.36	<0.0001	0.31 – 0.41

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: IRR for immediate change, IRR for change in slope, heterogeneity for both measures, absolute cumulative difference between expected and observed consultations, monthly average % difference;
2. A forest plot showing estimates by health facility and pooled estimate at health district level; and
3. One graph for health district showing the % deviation from expected value during the study period.

Standard forest plots summarizing meta-analysis results by indicator and by district are included in the supplementary material. These show IRR, CI, weight, standard error for each health facility, as well as the pooled result at district level. Measures of heterogeneity (I^2, τ^2 and p-value from test heterogeneity) are also presented in full in Supplementary material in annex 4.

4.2.1 Key results

The result overview is presented in figure 4, which shows point estimate and confidence interval for both outcome measures (IRR for immediate change and IRR for slope change) for each indicator and by health district. Key results include:

- **Outpatient department (OPD) consultations:** consistent immediate decrease within and across health districts. Results are not statistically significant. Heterogeneity was low in Bimbo, but ranged from moderate to high in other health districts.
- **Malaria consultations**: inconsistent results, no clear trend identified. High levels of heterogeneity for both estimates in Bangui 1, low heterogeneity for Bangui 2 and Bangui 3, and mixed for remaining health districts.
- **RTI consultations:** consistent decrease at the beginning of the pandemic, not statistically significant results, although magnitude of decrease was quite large in some health districts (drop by 36% in Bangui 2, and by 11% in Bégoua). There was a statistically significant decrease in change in slope in Bégoua (decrease by 3%). Overall, the results are in line with the decrease in new OPD

consultations; cumulative difference is negative. Heterogeneity was low in Bangui 1 for both estimates, but mixed for other health districts.

- **ANC1:** consistent decrease but results are not statistically significant, with exception of Bimbo, which had a statistically significant decrease (drop of 13%), and Bangui 2 (increase of 1%, not statistically significant). Heterogeneity was high for estimates in both Bangui 1 and Bangui 2, and low for both estimates in Bangui 3, Bégoua, and Bimbo.
- **Deliveries**: likely not robust results as very few facilities had sufficient data to be included in the analysis for the Bangui districts. Increase in deliveries may reflect a very small change in absolute number. Results in Bégoua and Bimbo also inconsistent. Difficult to say if deliveries were affected at the beginning and during the pandemic. Deliveries are less able to be planned and scheduled than other consultations.
- **BCG vaccine**: increase reported in 4 districts; however, number of health facilities reporting is low. Results difficult to interpret.
- **Family Planning**: results are inconsistent, relatively few facilities included and high heterogeneity in some districts. Difficult to interpret.
- **Hypertension:** very few average monthly consultations per health facility. Results not robust; increase in consultation (non-significant) difficult to interpret.

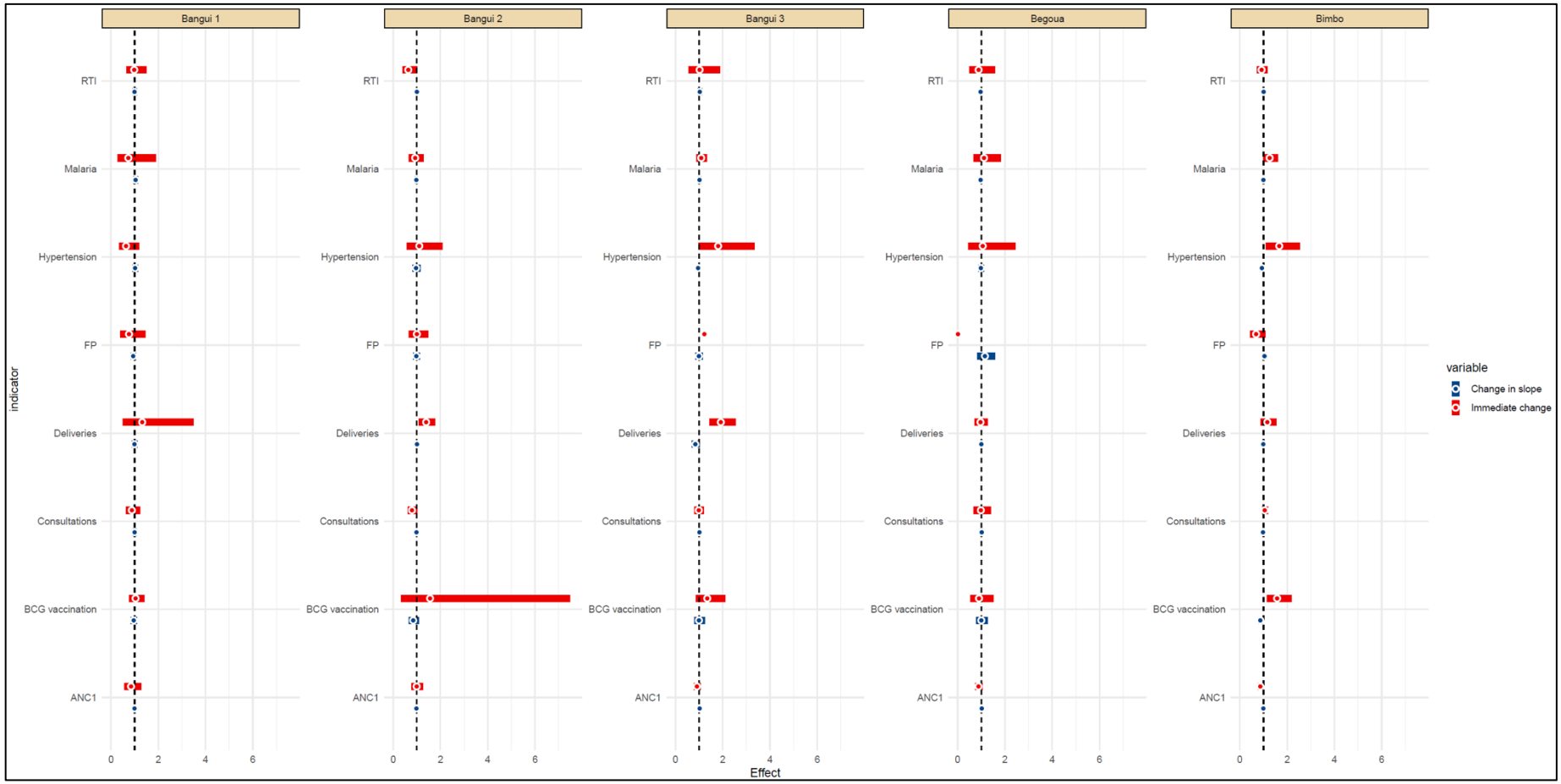

Figure 4: Forest plot for all indicators by health district, Central African Republic, 2017-2021

4.2.2 New outpatient consultations

A decrease in new outpatient consultations was observed at the beginning of the pandemic in four of the five districts (all except for Bimbo) (table 16 and figure 5). However, none of the results for immediate effect were statistically significant. Results for change in slope are all very close to 1, and we do not have enough evidence to conclude that there was a statistically significant difference in trends before COVID-19 compared to during the COVID-19 period.

Heterogeneity is low to moderate in the five districts, with exception of high level in change in slope in Bangui 1 and in immediate effect in Bégoua. I^2 ranges from 12% in Bimbo to 62% in Bégoua for immediate change; and from 0% in Bangui 2 to 69% in Bangui 1 for change in slope; p-value for test of heterogeneity ranges from p<0.01 to 0.32 for immediate effect, and from p<0.01 to 0.68 for change in slope. Forest plots including measures heterogeneity for each HD are provided in Supplementary materials (annex 4).

Cumulative differences range from -46,000 in Bégoua to +7,000 in Bangui 3. The average monthly change ranges from -34% in Bégoua to +21% in Bangui 3. Figure 6 shows the percent deviation from expected values by district: all districts but Bangui 3 show negative values during the COVID-19 period.

Table 16: Interrupted time series results for outpatient consultations by district, 2017 - 2021, Central African Republic

HD	N of HF	Measure	IRR	Heterogeneity	Cumulative difference	Average monthly % change
Bangui 1	7	Immediate effect	0.884 [0.628; 1.244]	Moderate	-38,121 [-61,185; -15,900]	-25 [-37; -5]
		Change in slope	1 [0.919; 1.088]	High		
Bangui 2	10	Immediate effect	0.795 [0.615; 1.028]	Low	-17,722 [-23,938; -11,348]	-13 [-33; 8,593]
		Change in slope	0.985 [0.956; 1.016]	Low		
Bangui 3	6	Immediate effect	0.989 [0.809; 1.208]	Moderate	7,250 [16,67; 12,435]	21 [6; 42]
		Change in slope	1.017 [0.97; 1.067]	Low		
Bégoua	17	Immediate effect	0.983 [0.684; 1.414]	High	-46,501 [-82,113; -19,922]	-34 [-53; -7]
		Change in slope	1.02 [0.968; 1.074]	Low		
Bimbo	15	Immediate effect	1.052 [0.937; 1.182]	Low	-14,390 [-27,341; -2,950]	-12 [-22; 1]
		Change in slope	0.98 [0.952; 1.009]	Low		

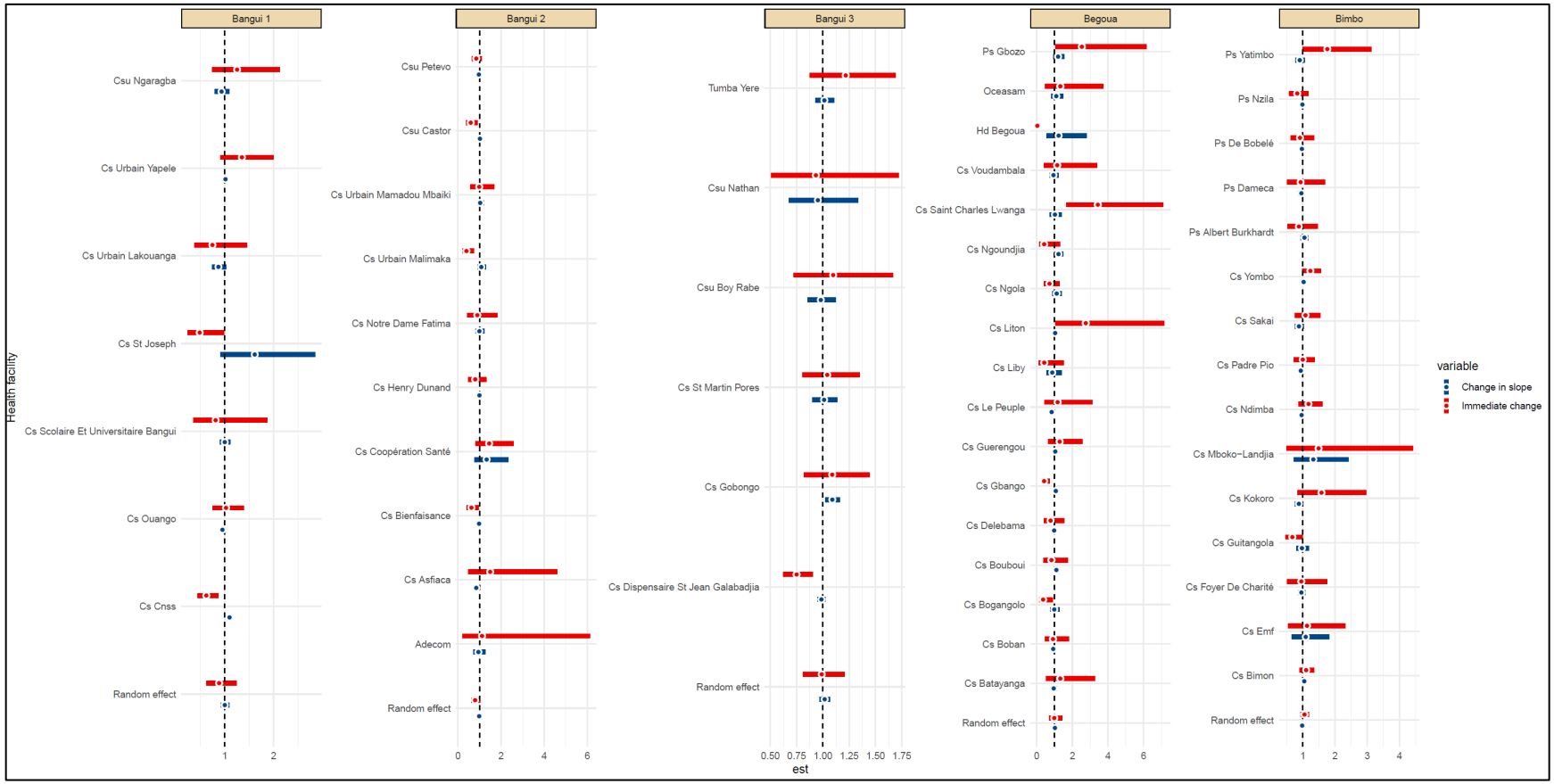

Figure 5: Forest plot for outpatient consultations by health facility and district, Central African Republic, 2017-2021

Note: CI for immediate change in HD Bégoua not displayed because too wide (up to 40).

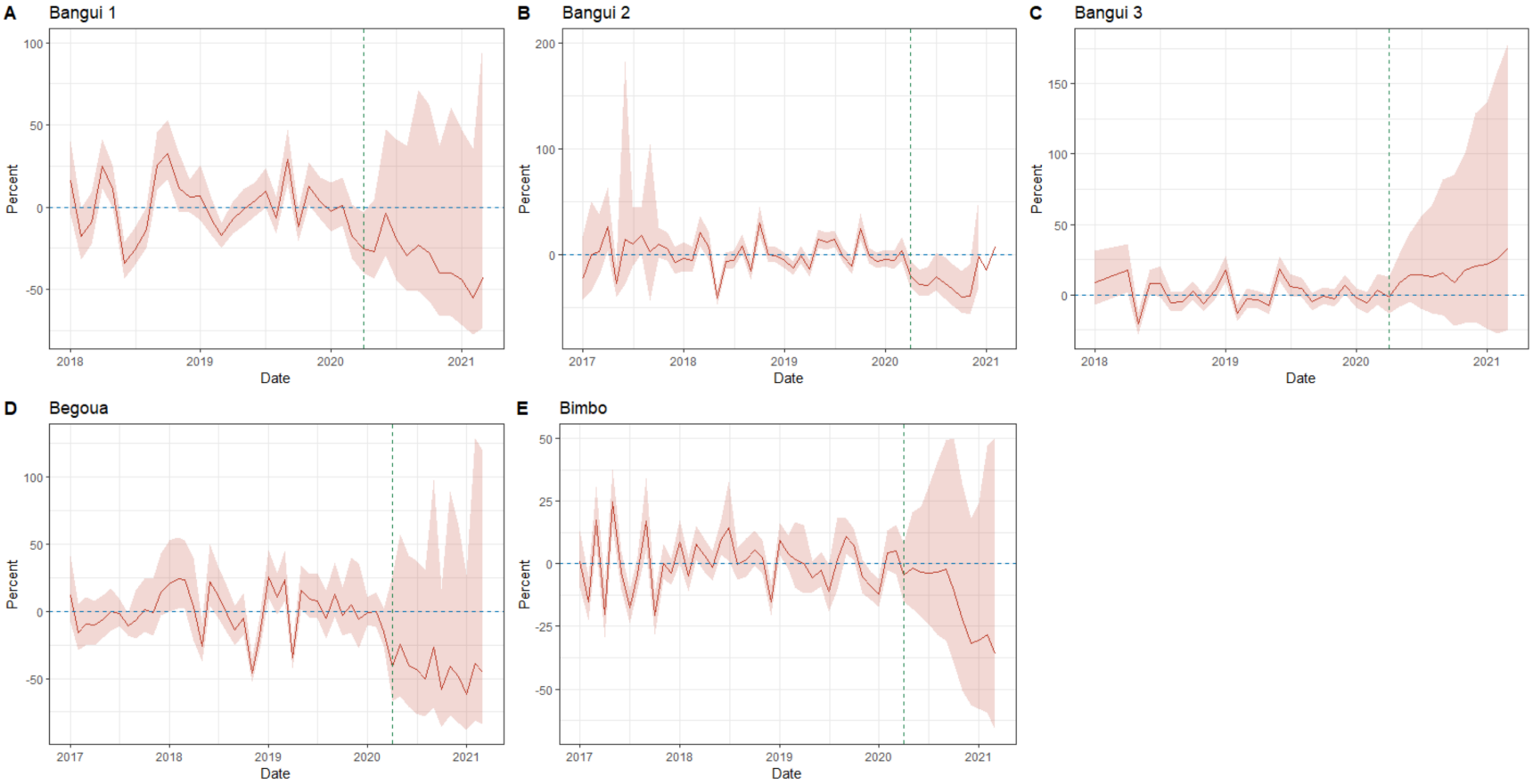

Figure 6. Percent deviation from expected values for outpatient consultations, by district, 2017 - 2021, Central African Republic

4.2.3 Malaria

A decrease in malaria consultations was observed at the beginning of the pandemic in two of the five districts (Bangui 1 and Bangui 2), while the other three districts show an increase (table 17 and figure 7). However, none of the results for immediate effect were statistically significant. Results for change in slope are all very close to 1, and we cannot observe any difference in trends before COVID-19 compared to during the COVID-19 period.

Estimates were overall more heterogeneous for malaria consultations than for overall consultations, although there was relatively low heterogeneity for both estimates in Bangui 2 and Bangui 3. In Bangui 1, there was high heterogeneity for both immediate effect (I^2=84%, p<0.01) and change in slope (I^2=60%, p=0.02). In Bégoua and Bimbo, there was relatively high heterogeneity in immediate effect estimates, and relatively low heterogeneity in change in slope estimates.

Cumulative differences range from -17,826 in Bégoua to +4,345 in Bangui 3. The average monthly change ranges from -36% in Bégoua to +35% in Bangui 2. Figure 8 shows the percent deviation from expected values by district: Bangui 1, Bangui 2 and Bégoua show mainly negative values during the COVID-19 period. In Bangui 2, the average monthly % change is heavily influenced by the high deviation in the last months of the study period.

Table 17: Interrupted time series results for malaria consultations by district, 2017 - 2021, Central African Republic

HD	N of HF	Measure	IRR	Heterogeneity	Cumulative difference	Average monthly % change
Bangui 1	7	Immediate effect	0.734 [0.285; 1.892]	High	-8,594 [-13,812; -3,283]	-19 [-31; 4]
		Change in slope	1.041 [0.941; 1.152]	High		
Bangui 2	9	Immediate effect	0.929 [0.67; 1.288]	Low	-6,593 [-10,068; -3,299]	35 [-20; 4,080]
		Change in slope	0.979 [0.911; 1.051]	Low		
Bangui 3	8	Immediate effect	1.091 [0.885; 1.344]	Low	4,345 [1,153; 6,998]	18 [5; 31]
		Change in slope	1.02 [0.955; 1.089]	Low		
Bégoua	18	Immediate effect	1.116 [0.684; 1.82]	High	-17,826 [-24,192; -11,621]	-36 [-46; -24]
		Change in slope	0.973 [0.931; 1.016]	Low		
Bimbo	17	Immediate effect	1.261 [0.983; 1.617]	High	2,894 [624; 4,996]	12 [3; 23]
		Change in slope	0.997 [0.963; 1.032]	Low		

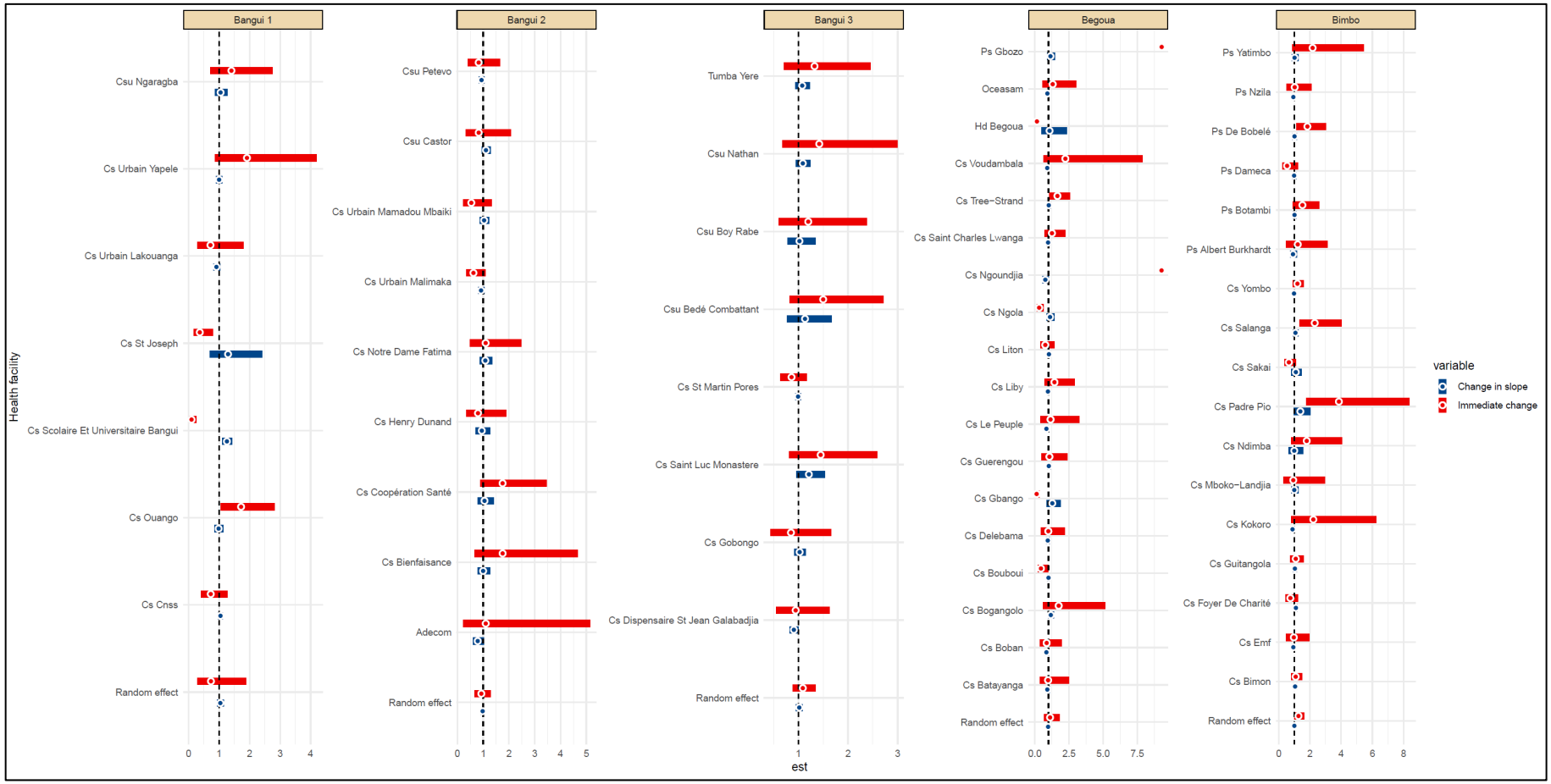

Figure 7: Forest plot for malaria consultations by health facility and district, Central African Republic, 2017-2021

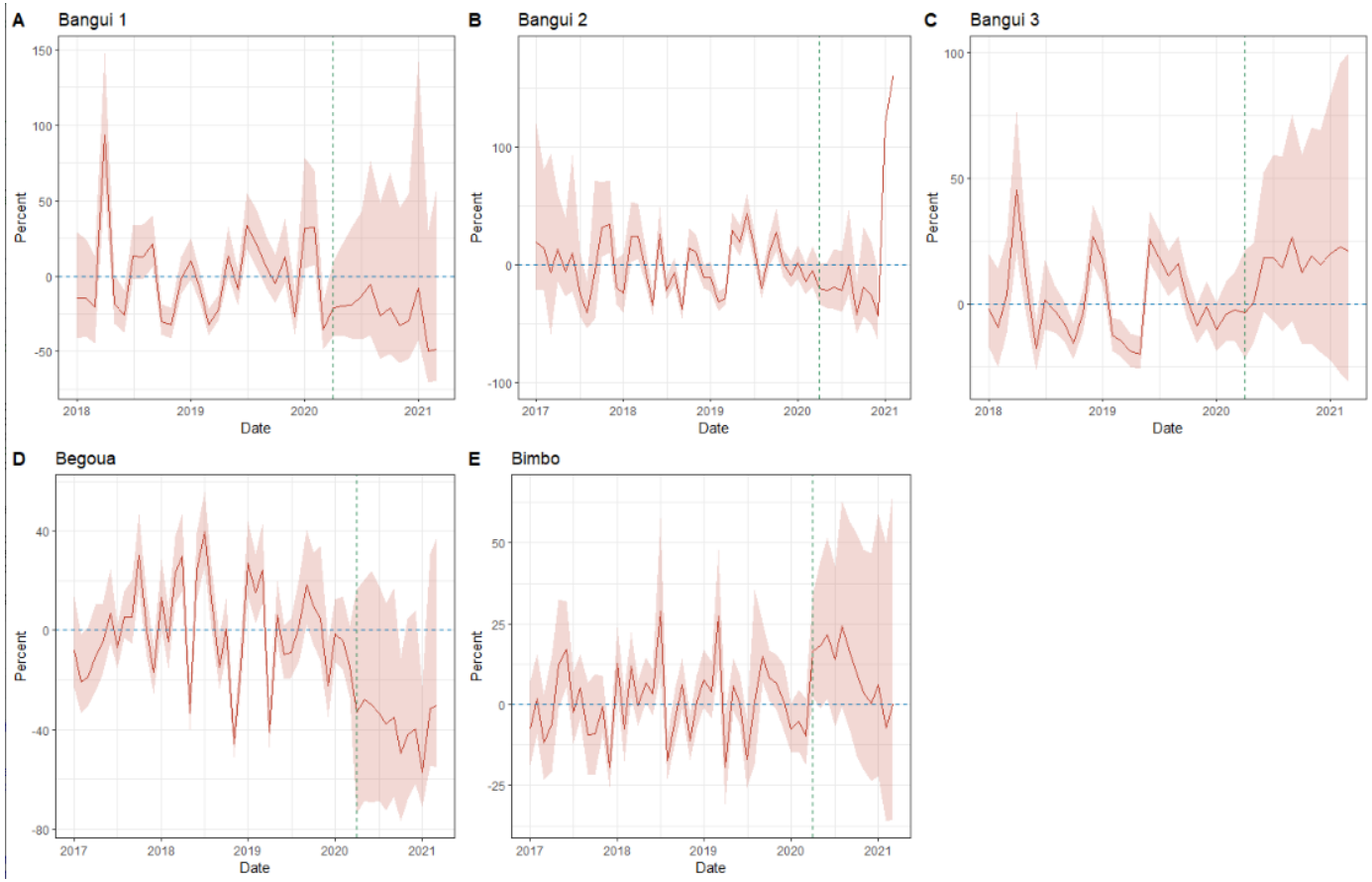

Figure 8: Percent deviation from expected values for malaria consultations, by district, 2017 - 2021, Central African Republic

Note: For Bangui 2, we truncated the y axis because the prediction interval is very wide for the last two months.

4.2.4 Respiratory Tract Infections

A decrease in consultations for RTIs was observed at the beginning of the pandemic in four of the five districts (all but Bangui 3) (table 18 and figure 9). However, none of the results for immediate effect were statistically significant. Results for change in slope are all very close to 1; there is not enough evidence to conclude that there was a significant change in trend from before COVID-19 compared to during the COVID-19 period. The only exception is in Bégoua (results in grey in table 18), where a 3% statistically significant decrease was reported (IRR: 0.972, 95%CI: 0.946-0.999).

Heterogeneity in estimates varied across health districts. Heterogeneity was overall low in Bangui 1 for both estimates of immediate change and change in slope (I^2=0%, p=0.42; and I^2=35%, p=0.18, respectively). In Bangui 2, estimates for immediate change were highly heterogeneous (I^2=57%, p=0.02), while estimates for change in slope exhibited low levels of heterogeneity (I^2=0%, p=0.83). For Bangui 3 and Bimbo, estimates for immediate effect were moderately heterogeneous, while estimates of change in slope suggested low heterogeneity. In Bégoua, estimates for immediate change were highly heterogeneous (I^2=42%, p=0.03), while estimates for change in slope did not exhibit strong heterogeneity (I^2=7%, p=0.37).

Cumulative differences range from -9,337 in Bégoua to +301 in Bangui 1. The average monthly change ranges from -52% in Bégoua to +742% in Bangui 2. Figure 10 shows the percent deviation from expected values by district: Bangui 2 and Bégoua show mainly negative values during the COVID-19 period. However, the last two months for Bangui 2 in particular have large uncertainty in estimates, especially for percent deviation from expected values. In January 2021, in Bangui 2, the percent deviation is 3.3% (95% CI: -85.7%, 16593%); in February 2021, percent deviation is 3.3% (95% CI: -81.7%, 14100%).

Table 18: Interrupted time series results for consultations for respiratory tract infections by district, 2017 - 2021, Central African Republic

HD	N of HF	Measure	IRR	Heterogeneity	Cumulative difference	Average monthly % change
Bangui 1	6	Immediate effect	0.984 [0.649; 1.494]	Low	301 [-1,394; 1,688]	7 [-6; 24]
		Change in slope	0.995 [0.905; 1.094]	Low		
Bangui 2	9	Immediate effect	0.639 [0.404; 1.011]	High	-8,496 [-12,824; -,931]	742 [-56; 2,535]
		Change in slope	1.002 [0.945; 1.063]	Low		
Bangui 3	5	Immediate effect	1.022 [0.55; 1.897]	Moderate	-46 [-1,415; 1,325]	6 [-14; 33]
		Change in slope	1.031 [0.932; 1.141]	Low		
Bégoua	13	Immediate effect	0.888 [0.496; 1.591]	High	-9,337 [-14,858; -5,479]	-52 [-63; -40]
		Change in slope	0.972 [0.946; 0.999]	Low		

HD	N of HF	Measure	IRR	Heterogeneity	Cumulative difference	Average monthly % change
Bimbo	17	Immediate effect	0.921 [0.72; 1.178]	Moderate	-706 [-2,191; 869]	-2 [-11; 8]
		Change in slope	1.007 [0.97; 1.044]	Low		

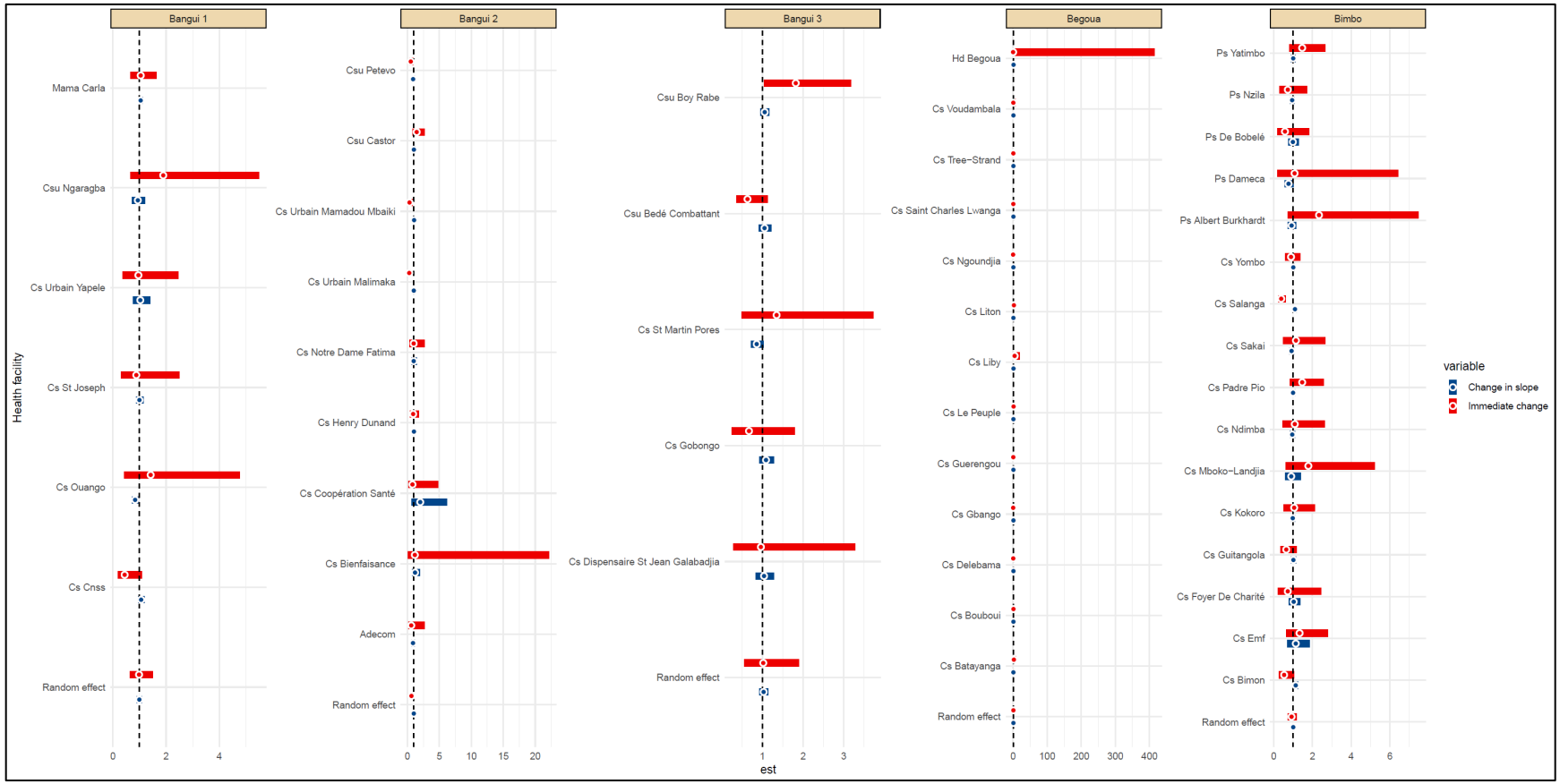

Figure 9: Forest plot for Respiratory tract infections consultations by health facility and district, Central African Republic, 2017-2021

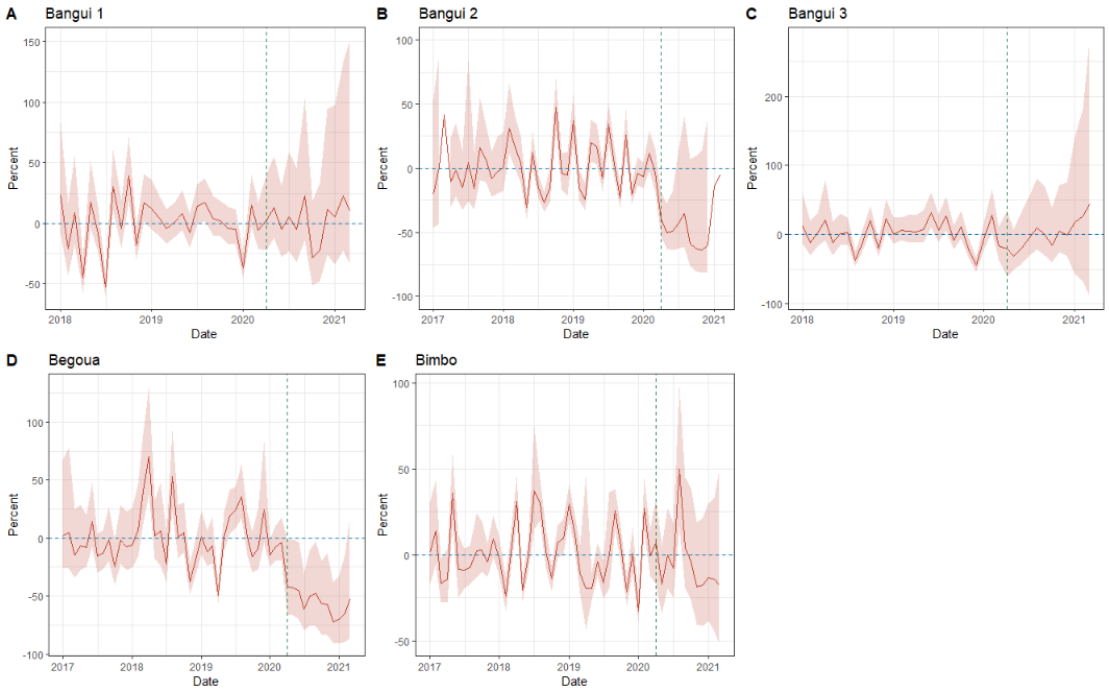

Figure 10: Percent deviation from expected values for Respiratory tract infection consultations, by district, 2017 - 2021, Central African Republic

Note: Bangui 2 has a strongly truncated y-axis for easier visualization. In Bangui 2, the 95% CI reaches 16593% in January 2021 and 14100% in February 2021.

4.2.6 Antenatal Care 1

A decrease in consultations for the first ANC visit was observed at the beginning of the pandemic in four of the five districts (all but Bangui 2) (table 19 and figure 11). However, only the results for immediate effect in Bimbo were statistically significant (IRR 0.866, 95%CI: 0.755-0.994, corresponding to a 13.4% decrease). Results for change in slope are all very close to 1, and we do not observe difference in trends before COVID-19 compared to during the COVID-19 period.

Heterogeneity is high for estimates of both immediate effect and change in slope in Bangui 1 and Bangui 2, and low for the remaining three health districts. For Bangui 1, in particular, I^2=77% and p<0.01 for estimates of immediate effect, and I^2=58% and p=0.03 for estimates of change in slope.

Cumulative differences range from -2,895 in Bimbo to +702 in Bangui 2. The average monthly change ranges from -28% in Bimbo to +11% in Bangui 2. Figure 12 shows the percent deviation from expected values by district: Bangui 1 and Bimbo show mainly negative values during the COVID-19 period, while deviations are more varying in the other districts.

Table 19: Interrupted time series results for first visit of antenatal care by district, 2017 - 2021, Central African Republic

HD	N of HF	Measure	IRR	Heterogeneity	Cumulative difference	Average monthly % change
Bangui 1	7	Immediate effect	0.882 [0.599; 1.299]	High	-913 [-1,286; -535]	-13 [-17; -8]
		Change in slope	0.996 [0.965; 1.027]	High		
Bangui 2	8	Immediate effect	1.014 [0.784; 1.311]	High	702 [235; 1,129]	11 [1; 40]
		Change in slope	0.984 [0.945; 1.025]	High		
Bangui 3	4	Immediate effect	0.852 [0.629; 1.155]	Low	-253 [-585; 76]	-5 [-12; 4]
		Change in slope	1.022 [0.953; 1.095]	Low		
Bégoua	15	Immediate effect	0.882 [0.749; 1.039]	Low	-198 [-435; 28]	-4 [-10; 3]
		Change in slope	1.018 [0.991; 1.046]	Low		
Bimbo	13	Immediate effect	0.866 [0.755; 0.994]	Low	-2,895 [-4,169; -1,790]	-28 [-35; -19]
		Change in slope	0.997 [0.977; 1.018]	Low		

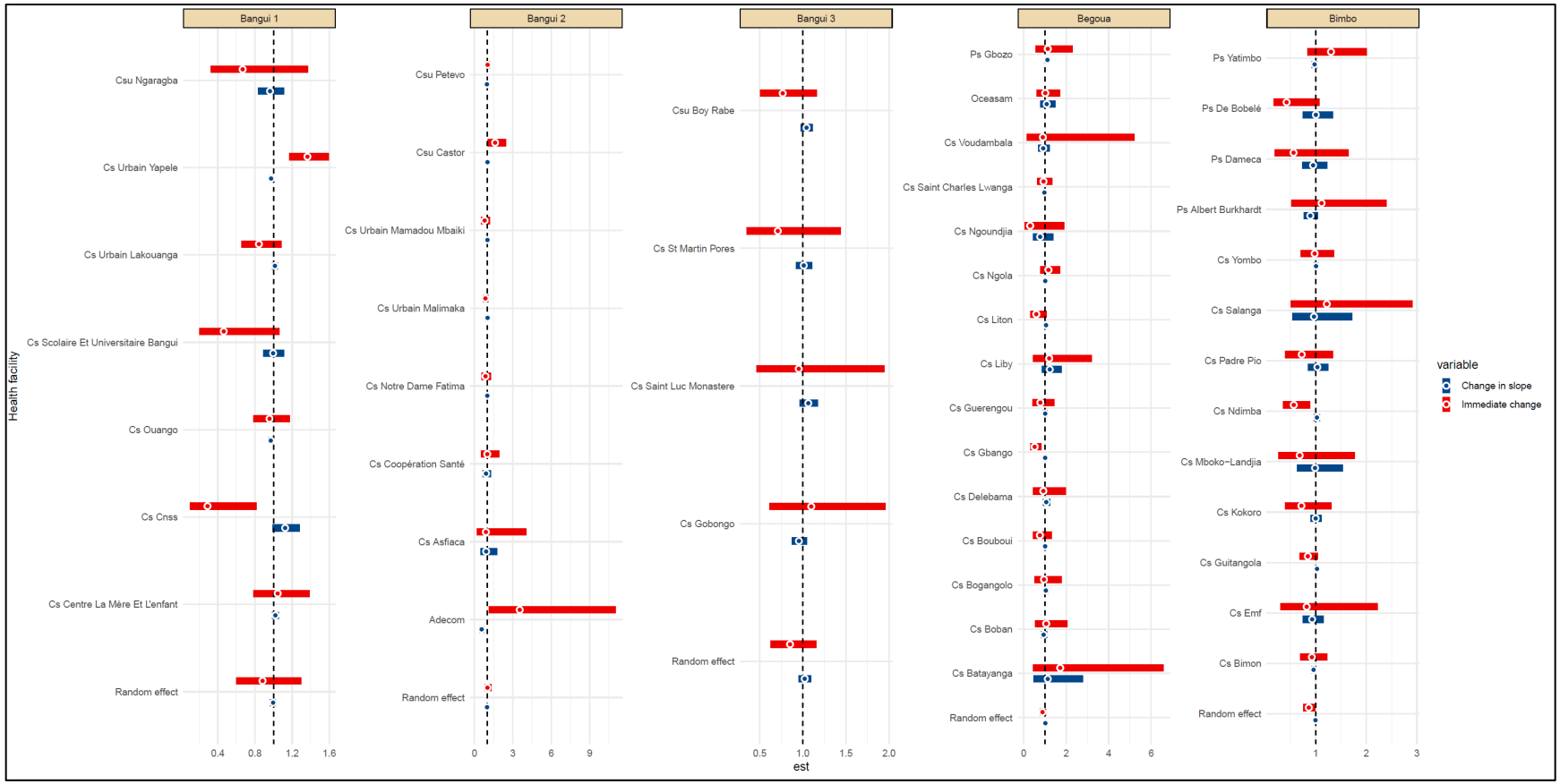

Figure 11: Forest plot for first visit of antenatal care by health facility and district, Central African Republic, 2017-2021

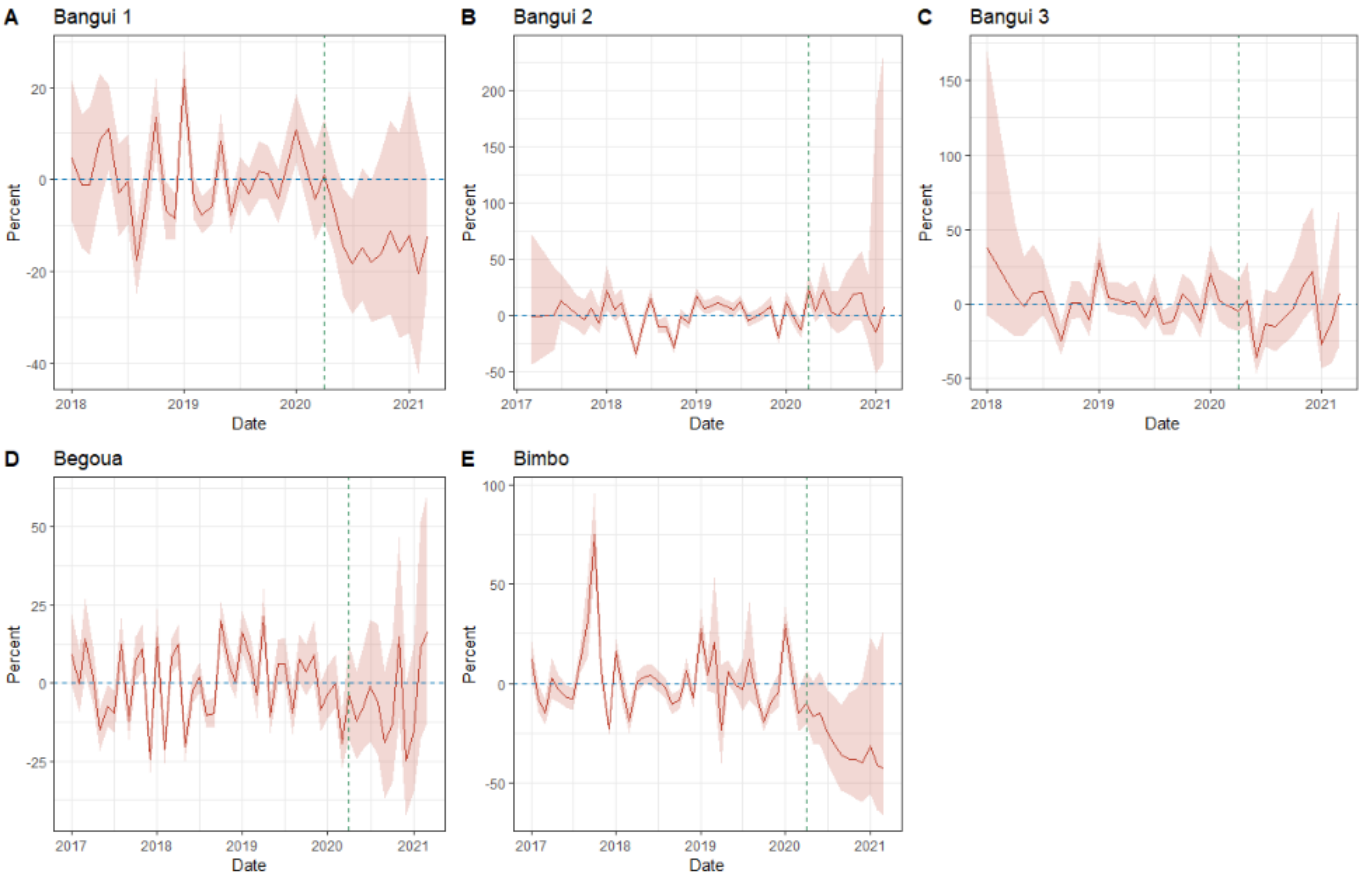

Figure 12: Percent deviation from expected values for antenatal care consultations, by district, 2017 - 2021, Central African Republic

4.2.7 Deliveries

An increase in institutional deliveries was observed at the beginning of the pandemic in four of the five districts (all but Bégoua) (table 20 and figure 13). Very few health facilities had sufficient data to be included in the analysis in the three Bangui districts. In Bangui 1, in particular, only one facility was included in analysis. All districts in Bangui seem reporting an increase in deliveries at the beginning of the pandemic, however this could reflect a small change in terms of absolute numbers (results for immediate effect in Bangui 2 (IRR: 1.393, 95%CI: 1.09-1.779, corresponding to a 39% increase) and Bangui 3 (IRR: 1.921, 95%CI: 1.451-2.542, corresponding to a 92% increase) were statistically significant. Results for change in slope are all very close to 1; we do not observe change in trends from before COVID-19 compared to during the COVID-19 period.

Heterogeneity was low for both immediate effect and change in slope estimates in Bangui 2 (I^2=0%, p=0.83 for immediate effect, and I^2=0%, p=0.62 for change in slope). It was high for both estimates in Bégoua and Bimbo, with p<0.1, and I^2 ranging from 48% for estimate of immediate effect to 77% for estimate of change in slope (both in Bégoua). In Bangui 3, heterogeneity was low for estimate of immediate effect (I^2=0%, p=0.91), and high for estimate of change in slope (I^2=50%, p=0.09).

Cumulative differences range from -2,183 in Bangui 2 to +437 in Bimbo. The average monthly change ranges from -14% in Bégoua to +71% in Bangui 1 (as mentioned above, only one facility from Bangui 1 met the inclusion criteria. Results are to be interpreted with caution). Figure 14 shows the percent deviation from expected values by district: Bangui 1 and Bangui 2 show quite small deviation from the expected value both before and during COVID-19, while Bégoua and Bimbo show extensive variability. Bangui 3 and Bimbo show positive values during most of the COVID-19 period.

For this indicator, model fit is poor to moderate for many health facilities. For Bangui 2, some of the model checks indicate poor fit (Supplementary materials, annex 4). The absolute numbers of deliveries are quite low in most facilities, and results should be interpreted with caution.

Table 20: Interrupted time series results for institutional deliveries by district, 2017 - 2021, Central African Republic

HD	N of HF	Measure	IRR	Heterogeneity	Cumulative difference	Average monthly % change
Bangui 1	1	Immediate effect	1.322 [0.502; 3.481]	N/A	342 [-9; 661]	71 [11; 1897]
		Change in slope	0.993 [0.882; 1.117]	N/A		
Bangui 2	4	Immediate effect	1.393 [1.09; 1.779]	Low	-2,183 [-5,516; 1,093]	30 [-50; 403]
		Change in slope	1.006 [0.944; 1.072]	Low		
Bangui 3	5	Immediate effect	1.921 [1.451; 2.542]	Low	245 [-152; 616]	12 [-8; 38]
		Change in slope	0.844 [0.698; 1.021]	High		

HD	N of HF	Measure	IRR	Heterogeneity	Cumulative difference	Average monthly % change
Bégoua	15	Immediate effect	0.968 [0.73; 1.284]	High	-310 [-454; -169]	-14 [-20; -7]
		Change in slope	1.004 [0.933; 1.081]	High		
Bimbo	14	Immediate effect	1.164 [0.877; 1.543]	High	437 [130; 774]	11 [4; 19]
		Change in slope	0.992 [0.94; 1.047]	High		

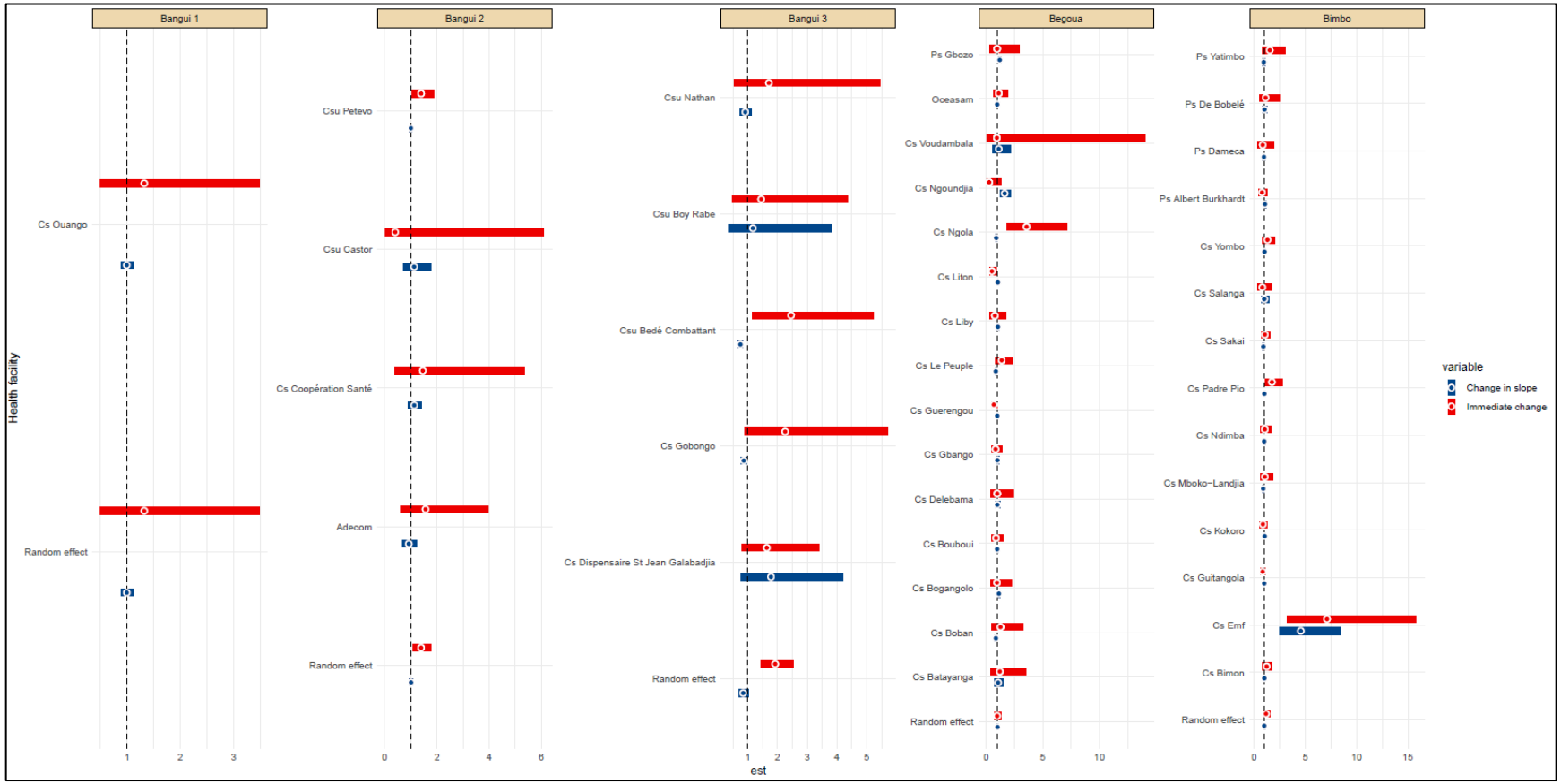

Figure 13: Forest plot for institutional deliveries by health facility and district, Central African Republic, 2017-2021

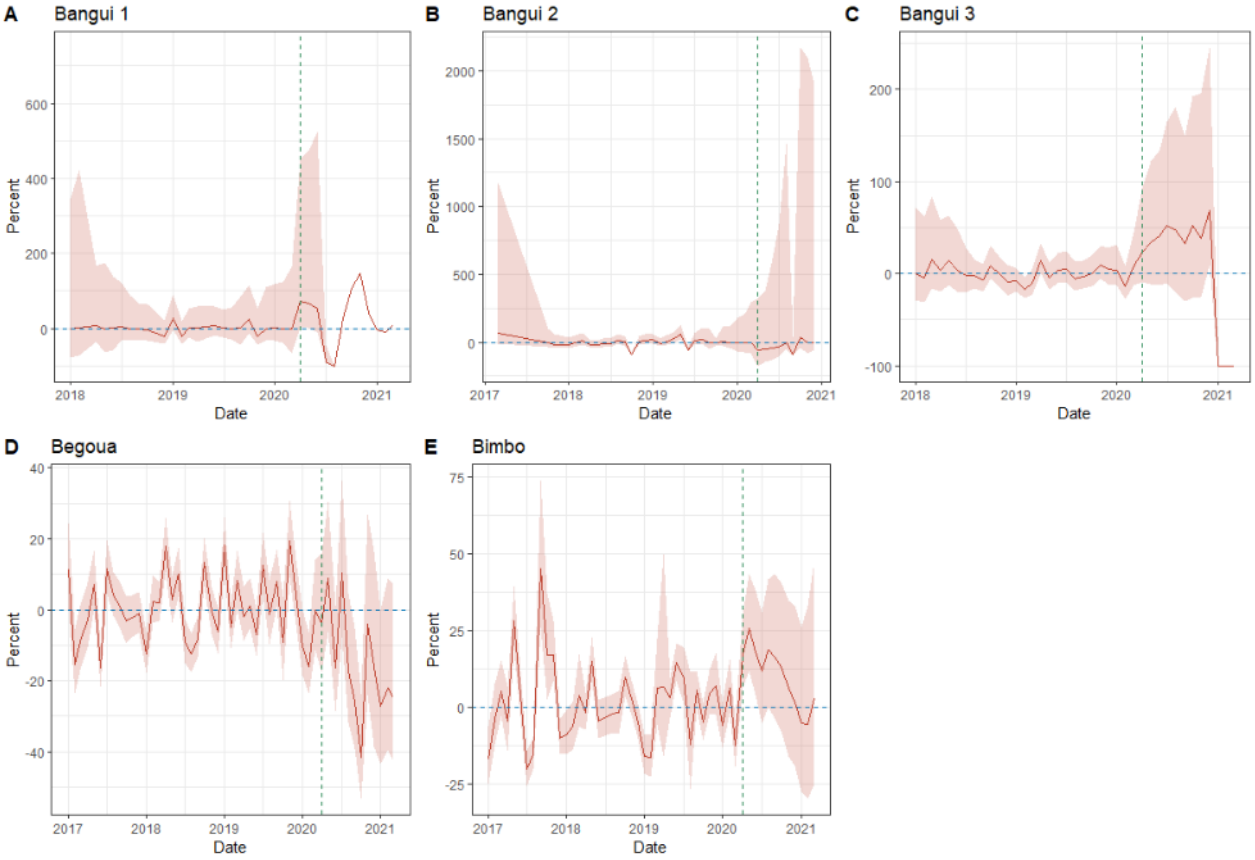

Figure 14: Percent deviation from expected values for institutional deliveries, by district, 2017 - 2021, Central African Republic

4.2.8 BCG Vaccine

An increase in delivery of BCG vaccine doses was observed at the beginning of the pandemic in four of the five districts (all but Bégoua) (table 21 and figure 15). Results for immediate effect in Bimbo (IRR: 1.577, 95%CI: 1.136-2.19, corresponding to a 58% increase) were statistically significant. Results for change in slope are quite close to 1. The estimate for change in slope in Bimbo is statically significantly different from 1 (IRR: 0.867, 95%CI: 0.802-0.938) and corresponds to a 13% decrease in trend during the COVID-19 period compared to before COVID-19.

Heterogeneity was low for estimates of immediate effect and change in slope in Bangui 1, and Bangui 2. It was high for both estimates in Bégoua. Heterogeneity was mixed for the estimates in Bangui 3 and Bimbo. In both, heterogeneity was low for estimate of immediate effect, and high for change in slope.

Cumulative differences range from -2,660 in Bégoua to +2,399 in Bangui 3. The average monthly change ranges from -46% in Bégoua to +72% in Bangui 3. Figure 16 shows the percent deviation from expected values by district: all districts but Bangui show negative estimates during most of the COVID-19 period.

Model fit was poor to moderate for some of the health facilities, especially for Bangui 1 and Bangui 3. For this indicator, there was extensive variation in number of children vaccinated in the pre-COVID period from month to month.

Table 21: Interrupted time series results for BCG vaccination by district, 2017 - 2021, Central African Republic

HD	N of HF	Measure	IRR	Heterogeneity	Cumulative difference	Average monthly % change
Bangui 1	5	Immediate effect	1.04 [0.765; 1.415]	Low	-1,574 [-2,655; -657]	-24 [-43; 4]
		Change in slope	0.963 [0.84; 1.105]	Low		
Bangui 2	3	Immediate effect	1.56 [0.326; 7.466]	Low	-659 [-1,054; -249]	-22 [-47; 485]
		Change in slope	0.847 [0.664; 1.081]	Low		
Bangui 3	5	Immediate effect	1.347 [0.86; 2.11]	Low	2,399 [1,599; 3,056]	72 [41; 121]
		Change in slope	0.996 [0.8; 1.24]	High		
Bégoua	9	Immediate effect	0.905 [0.543; 1.506]	High	-2,660 [-3,172; -2,247]	-46 [-52; -41]
		Change in slope	1.003 [0.793; 1.269]	High		
Bimbo	7	Immediate effect	1.577 [1.136; 2.19]	Low	-1,382 [-1,989; -796]	-22 [-31; -12]
		Change in slope	0.867 [0.802; 0.938]	High		

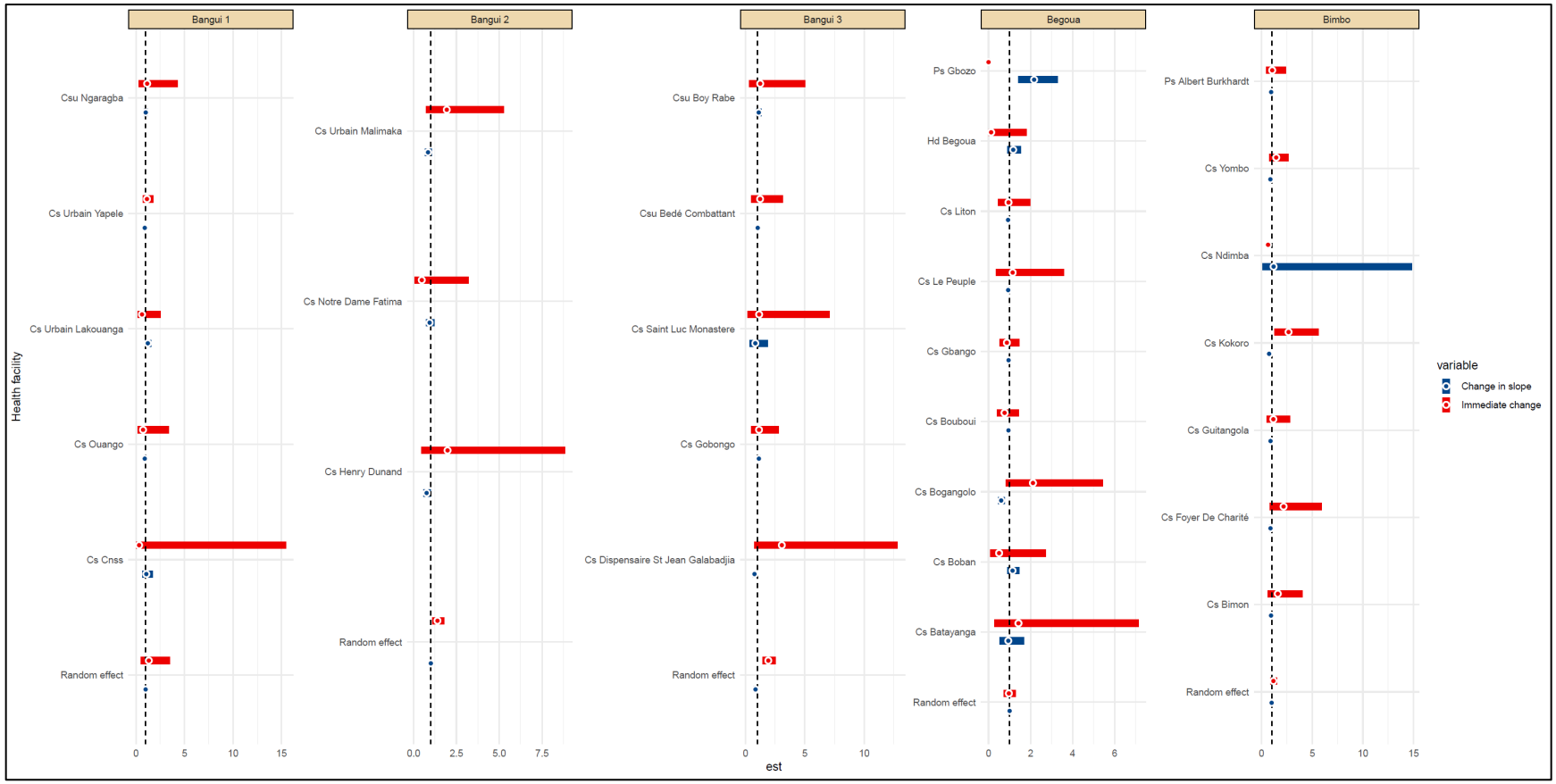

Figure 15:Forest plot for BCG vaccination by health facility and district, Central African Republic, 2017-2021

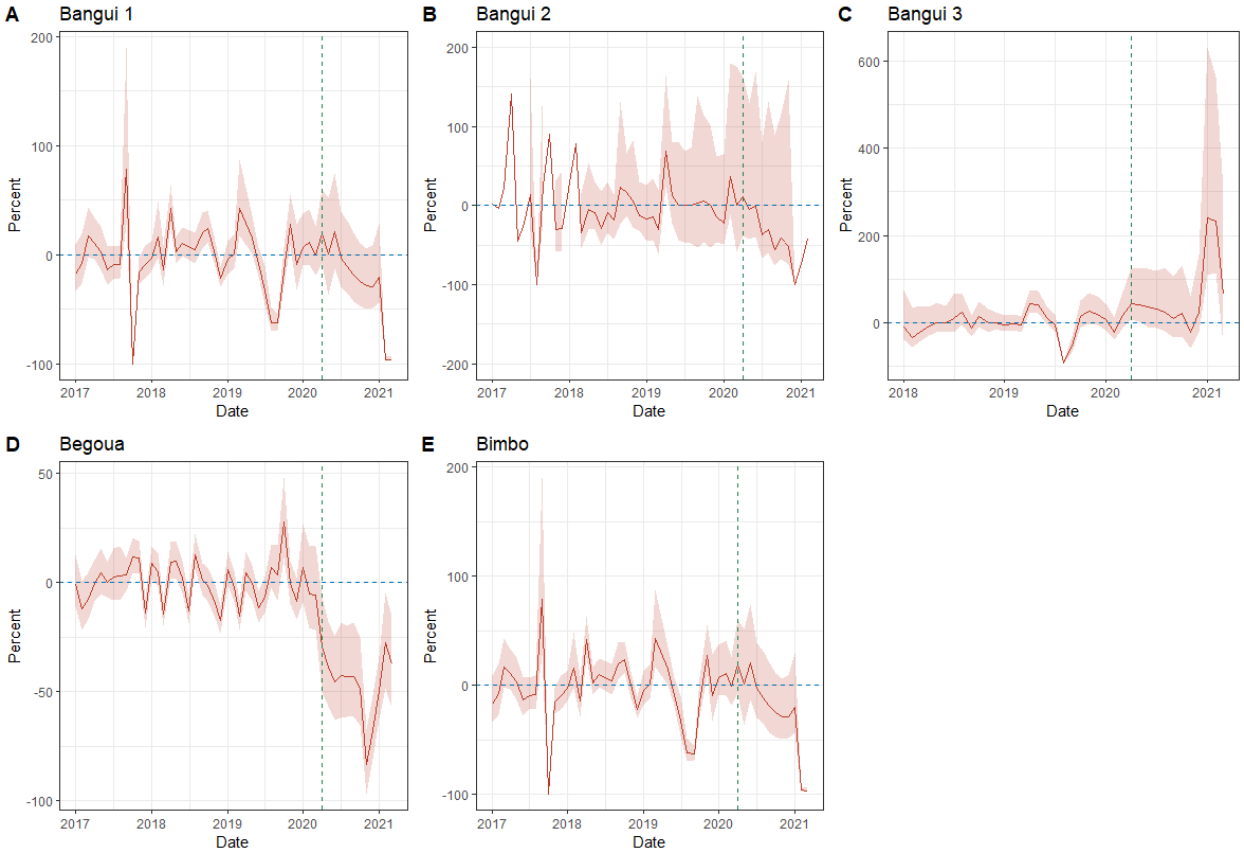

Figure 16: Percent deviation from expected values for BCG vaccination, by district, 2017 - 2021, Central African Republic

4.2.9 Family Planning

A decrease in consultations for family planning was observed at the beginning of the pandemic in three districts (Bangui 1, Bégoua and Bimbo) (table 22 and figure 17). None of the results are however statistically significant. Results for change in slope are quite close to 1 and none is statistically significant.

Heterogeneity was low in Bangui 1 for both estimates of immediate effect and change in slope. However, for remaining HD, heterogeneity ranged from low to high.

Cumulative differences range from -9,140 in Bangui 1 to +368 in Bangui 2. The average monthly change ranges from -46% in Bangui 1 and Bégoua to +10% in Bangui 3. Figure 18 shows the percent deviation from expected values by district: Bangui 1, Bégoua and Bimbo show mainly negative values during the COVID-19 period.

Model fit is poor for some of the health facilities. For Gbango HF, located in Bégoua, in particular, the estimate of immediate change is 9.81, whereas for two other health facilities in Bégoua, estimate of IRR was 0.00, which explains the wide confidence interval. As few health facilities had sufficient data to be included in the analysis, results are not very robust and should be interpreted with caution.

Table 22: Interrupted time series results for family planning consultations by district, 2017 - 2021, Central African Republic

HD	N of HF	Measure	IRR	Heterogeneity	Cumulative difference	Average monthly % change
Bangui 1	7	Immediate effect	0.762 [0.402; 1.445]	Low	-9,140 [-13,950; -5,250]	-50 [-61; -36]
		Change in slope	0.941 [0.841; 1.051]	Low		
Bangui 2	6	Immediate effect	1.001 [0.671; 1.492]	Low	368 [-2,257; 2,380]	8 [-8; 27]
		Change in slope	0.978 [0.84; 1.139]	High		
Bangui 3	4	Immediate effect	1.225 [0.074; 20.271]	High	-4,598 [-11,846; 2,565]	10 [-22; 1667]
		Change in slope	0.995 [0.856; 1.156]	Low		
Bégoua	5	Immediate effect	0.016 [0; 169.785]	High	-3,702 [-8,118; -1,257]	-50 [-71; -11]
		Change in slope	1.155 [0.839; 1.591]	Moderate		
Bimbo	10	Immediate effect	0.687 [0.442; 1.069]	Moderate	-1,567 [-2,557; -674]	-22 [-34; -3]
		Change in slope	1.042 [0.973; 1.117]	Low		

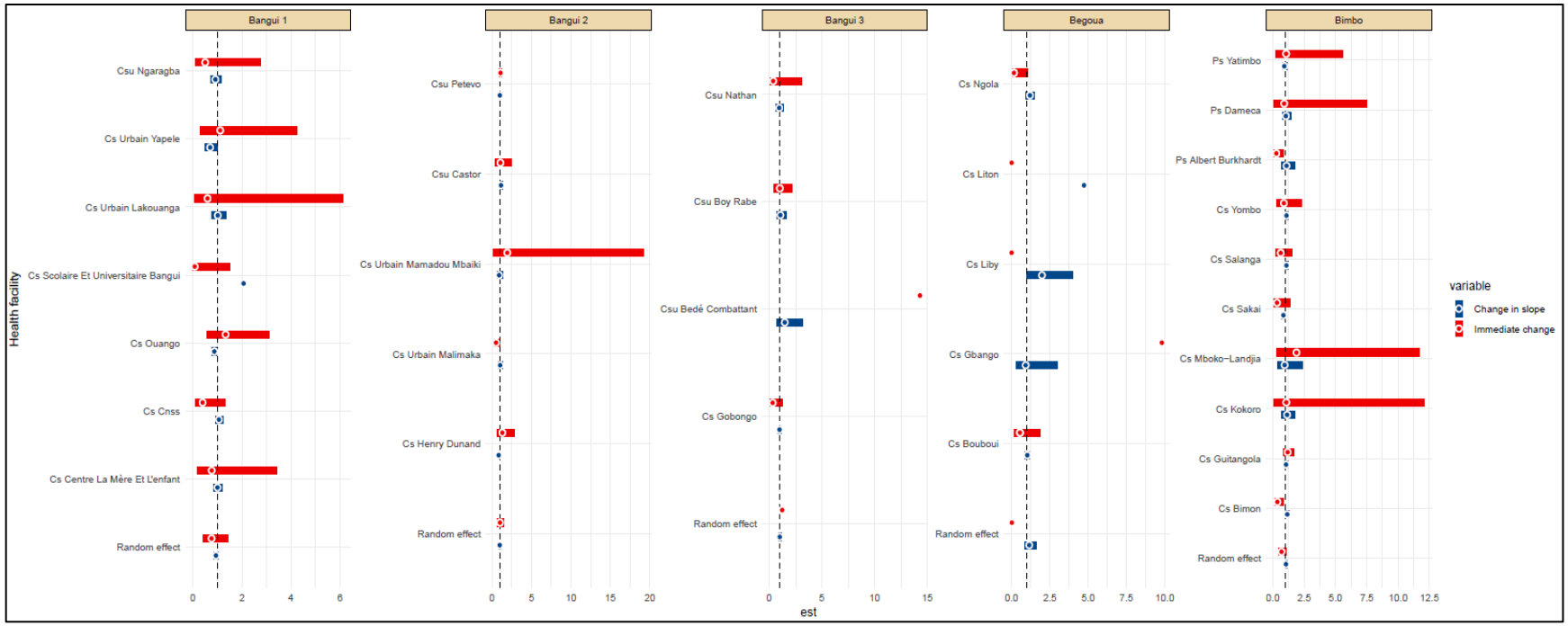

Figure 17: Forest plot family planning consultations by health facility and district, Central African Republic, 2017-2021

Note that we did not display confidence intervals above 20.

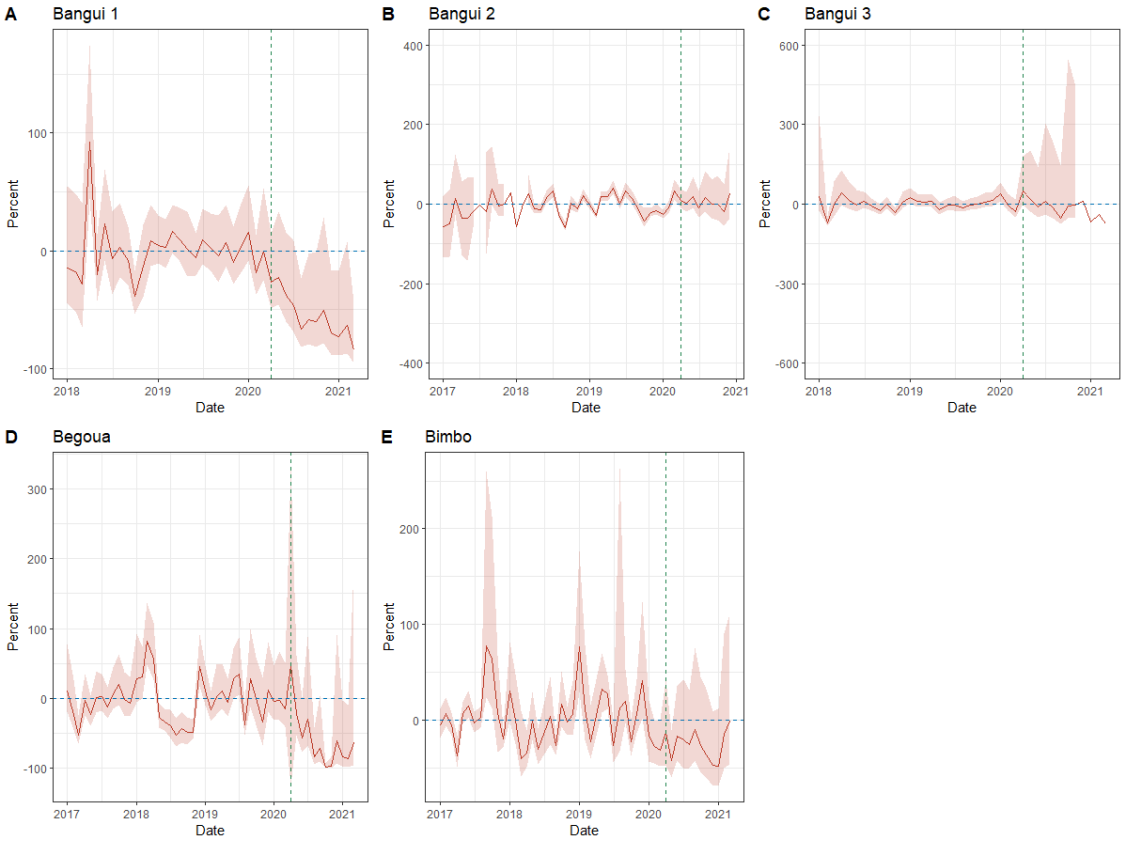

Figure 18: Percent deviation from expected values for family planning consultations, by district, 2017 - 2021, Central African Republic

4.2.10 Hypertension

Overall numbers of consultations for hypertension are low (average monthly consultation ranging from 1 to 47, see supplementary material), making results quite unstable. They need to be interpreted with caution. The model does not adequately capture variations in this indicator in the pre-COVID-19 period, with residuals for many facilities violating the assumption of normalcy, and Q-Q plots clearly indicating a poor fit (supplementary material, annex 4).

An increase in consultations for hypertension was observed at the beginning of the pandemic in four of the five districts (all but Bangui 1) (table 23 and figure 19). None of the results are however statistically significant. Results for change in slope are quite close to 1 and none is statistically significant, with exception of immediate change in Bimbo (IRR=1.667, 95% CI: 1.093 – 2.54).

Heterogeneity (I^2) ranges from low in Bangui 1 for both estimates to high in Bangui 2 for both estimates. In remaining three HD, levels of heterogeneity varied for estimate of immediate effect and for estimate of change in slope. In Bégoua, there was high heterogeneity for estimate of immediate effect (I^2=54%, p=0.02), while in Bimbo, there was high heterogeneity for estimate of change in slope (I^2=38%, p=0.09).

Cumulative differences range from -669 in Bégoua to +37 in Bimbo. The average monthly change ranges from -55% in Bégoua to +49% in Bangui 3. Figure 20 shows the percent deviation from expected values by district: discrepancies from expected values are quite high in all districts.

Table 23: Interrupted time series results for hypertension consultations by district, 2017 - 2021, Central African Republic

HD	N of HF	Measure	IRR	Heterogeneity	Cumulative difference	Average monthly % change
Bangui 1	7	Immediate effect	0.637 [0.344; 1.179]	Low	-276 [-443; -117]	-20 [-35; 10]
		Change in slope	1.019 [0.904; 1.149]	Low		
Bangui 2	8	Immediate effect	1.104 [0.583; 2.09]	High	-94 [-165; -29]	36 [5; 64]
		Change in slope	0.968 [0.819; 1.144]	High		
Bangui 3	6	Immediate effect	1.808 [0.978; 3.34]	Moderate	9 [-749; 536]	49 [6; 105]
		Change in slope	0.959 [0.891; 1.032]	Low		
Bégoua	9	Immediate effect	1.062 [0.46; 2.452]	High	-669 [-809; -524]	-55 [-61; -46]
		Change in slope	0.984 [0.872; 1.111]	Moderate		
Bimbo	12	Immediate effect	1.667 [1.093; 2.54]	Moderate	37 [-49; 122]	7 [-5; 20]
		Change in slope	0.933 [0.861; 1.012]	High		

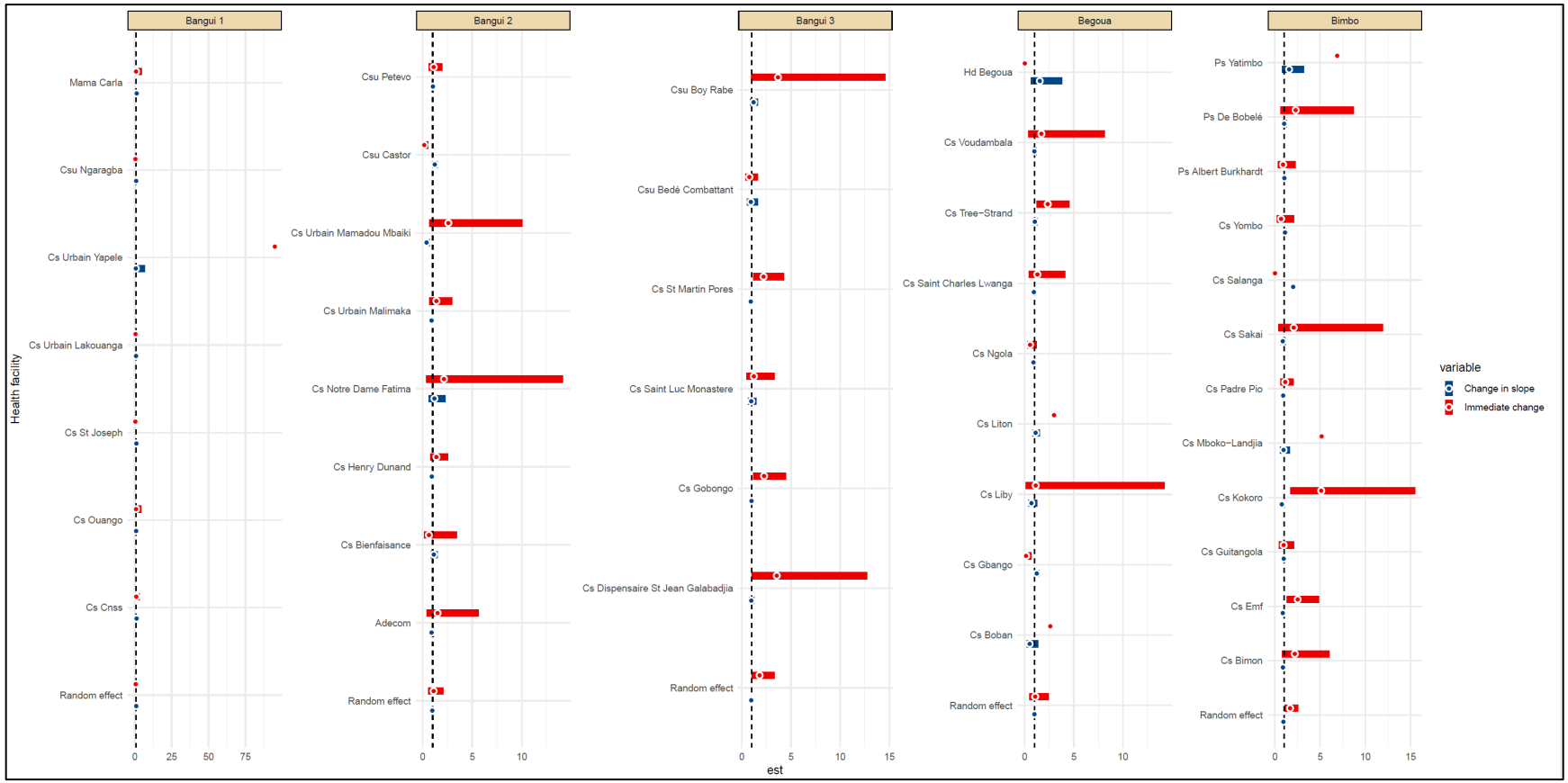

Figure 19: Forest plot for hypertension consultations by health facility and district, Central African Republic, 2017-2021

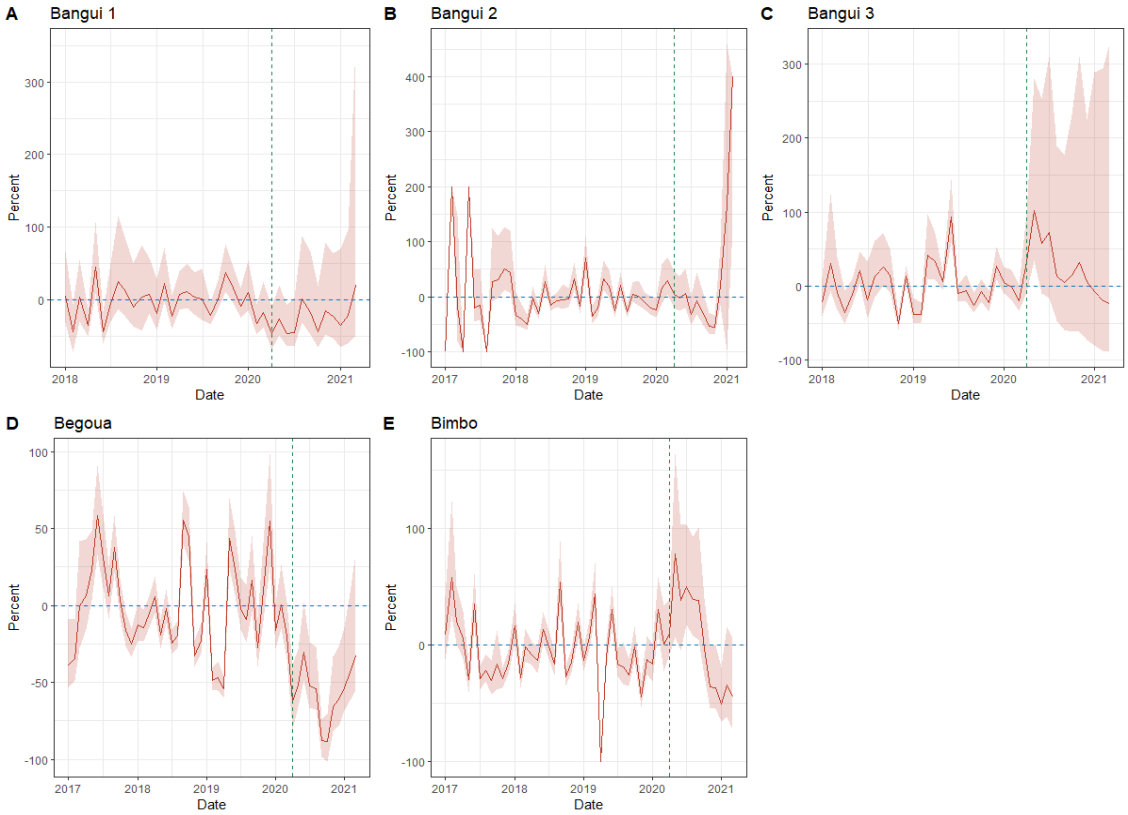

Figure 20: Percent deviation from expected values for hypertension consultations, by district, 2017 - 2021, Central African Republic

4.3 Health care workers perceptions

4.3.1 Key results

- **Violence and population displacement** following presidential elections impacted the capacity to implement COVID-19 measures.
- Several **public health and social measures** occurred at the national level against COVID-19 including physical distancing, mask wearing, handwashing or hand friction with hydroalcoholic gel, closure of schools, churches, mosque and shops, ban on gatherings of more than 15 people, remote working/teleworking, limiting the number of patients in the waiting room.
- At the beginning of the crisis, respondents were apprehensive about COVID-19; this changed over time as they understood the need to adapt their behavior in the face of the crisis and accepted to implement preventive measures in their facilities.
- Introduction of preventative measures due to COVID-19 led to the **reorganization of health services** including the installation of hand washing stations, introduction of temperature control at the facility entrance, establishment of isolation rooms, reduction of number of patients to ensure compliance with barrier measures, and introduction of new patient flow.
- Reported **drop in consultations** (infectious diseases, NCDs, child health, vaccinations) and in laboratory tests (as linked to consultations) was reported by most respondents.
- Most frequently reported **reasons for not going to health facilities**: fear of being infected, fear of being tested, and increased waiting times.
- Reported **increase in referrals** from health facilities (as more cases were suspected to have COVID-19).
- Reported **drug stockouts** due to border closure.
- **Maternal and Child Health services perceptions:**
    - Deliveries: some reported no changes and others reported a decrease (hypothesis is that more women delivered at home)
    - ANC: duration and frequency of this service was reported as decreased
    - Family planning: mixed responses as some reported reduction, no change and one reported an increase.
- Focus of attention, including financial resources, at health facilities, community outreach, training, etc. was **shifted to COVID-19** at expense of other diseases and health topics.
- **Human resources**: Task shifting and termination of contracts due to lack of funding; HR shortages due to illness and delays in reporting to work.
- Reduced income available at HF due to reduced consultations.

4.3.2 Participant profile

Table 24 shows the characteristics of the participants in the qualitative interviews. The average age was 43.7 years, ranging from 26 to 60 years. There were almost as many men as women (51.7% versus 49.3%) and as many medical staff as paramedics. Only two pharmacists were interviewed. One half of the respondents had a secondary school level education, and the other half held a university degree. One cleaning agent had completed primary school.

Table 24: Profile of respondents to the qualitative interviews on health care workers perceptions

N = 26	Frequency	Percentage
Age (mean + sd; range)	43.72 ± 8.6 [26, 60]	
Sex		
Male	15	51.7%
Profession		
Doctors	1	20.7%
Medical health district officer	5	17.2%
Nurse	6	20.7%
Midwife	5	17.2%
Biomedical Engineer	4	13.8%
Cleaning agent	6	20.7%
Pharmacist	2	6.9%
Level of education		
Primary school	1	3.4%
Secondary school	14	48.3%
University	14	48.3%

4.3.3 Context and introduced measures

There was general agreement among the respondents that the first COVID-19 case identified in CAR was a priest who came from Europe and presented symptoms related to COVID-19 a few days following his arrival in the country (case declared on March 14, 2020). Following the identification of the first confirmed COVID-19 case, a national committee was created, and a response strategy defined. This strategy included case definition, a national case management protocol, mass screening, creation of isolation sites, guidance regarding room layout, and the creation of rapid response teams.

Several public health and social measures occurred at the national level against COVID-19 (table 25). According to the respondents, these included physical distancing, mask wearing, handwashing or hand friction with hydroalcoholic gel, closure of schools, churches, mosque and shops, ban on gatherings of more than 15 people, remote working/teleworking, limiting the number of patients in the waiting room. Physical distancing, mask wearing, handwashing and ban on gatherings of more than 15 people were the most cited public health measures against COVID-19 in CAR and lasted 2–3 months according to some respondents.

Table 25: COVID-19 and public health measures introduced in CAR

COVID-19 and public health measures	Number of respondents
• Physical distancing	26
• Mask wearing	24
• Handwashing /hand friction with hydroalcoholic gel	25
• Closure of school, university, churches, mosque and shops	17
• Ban on gatherings of more than 15 people	21
• Remote working / teleworking	15
• Limiting the number of patients in the waiting room	1

Other events that impacted the response policies against COVID-19 included violence following the Presidential elections at the end of year 2020 was mentioned by 18/26 respondents, and population displacement following electoral violence was mentioned by two respondents. As a result, the most difficult periods were the first months following the outbreak of the virus, and at the end of 2020 that marked the election period. Two HCWs reported not experiencing any impact due to external factors other than COVID-19.

4.3.4 Changes and adaptations by health service

In general, almost all respondents reported changes that affected provision of health care during the COVID-19 pandemic. In fact, the introduction of preventative measures led to the reorganization of health services. For example, hand-washing stations were installed, temperature control was introduced at facility gates, isolation rooms needed to be and were created, the number of patients waiting in the waiting rooms was reduced, and in some cases a new care pathway within the facility was defined. Changes reported by the HCWs are presented by health service and summarized in Table 26.

Communicable and non-communicable diseases

Only HCWs directly involved in patient consultations were asked to answer the questions relating to curative care and management of chronic diseases. Thus, pharmacists and cleaning agents did not provide any information on these issues.

Eighteen respondents reported that most curative care and treatment of chronic diseases services were provided at their facilities. These included the management of malaria, respiratory infection, diarrhea, treatment of chronic disease (hypertension, diabetes, HIV/AIDS, etc). Three HCWs from Gbozo, Liby and Bégoua reported no impact of COVID-19 on curative care services. For all other respondents, COVID-19 impacted curative care and treatment of chronic diseases services in many ways. The most important impact was a drop in patients' attendance likely due to the population's fear of becoming infected at the facility, but also due to the need to reorganize prevention and health care services to comply with barrier measures. The latter included the reorganization of spaces in the facility, which reduced the possibility of accommodating people leading to longer waiting time (and some patients ended up leaving the facility).

A few health facilities reported other specific reasons that may have contributed to the drop in patient attendance. For example, in Castor facility in health region Bangui 2, there was a confirmed case of COVID-19 among a health care worker who was known by the population. This reinforced the fear of being contaminated with COVID-19 at that health care facility and caused the population to flee the facility. On the other hand, some populations did not want to comply with the preventative measures. This last factor had been reported in two facilities, district hospital of Bimbo and "Le Peuple" facility. In Pata facility, treatment of chronic disease service was interrupted due to a lack of screening equipment.

Child health services

Seventeen respondents answered questions concerning the availability of children health care services. Seven HCWs reported no change in the overall approach of integrated management of childhood illness including acute malnutrition due to COVID-19. Among them, four were nurses, one medical doctor, one

midwife and one pharmacy agent. According to the others who reported changes in children health care services, the number of children decreased for various reasons, including parents' fear of COVID-19 leading to not bringing their children to the hospital and due to the need to reorganize health care services such as the redeployment of certain HCWs, the reduced frequency of consultation days per week for children in the two facilities of "Notre Dame de Fatima" and district hospital of Bimbo.

Minor surgery and referral cases

Activities listed under minor surgery included circumcision, wound dressings, and sutures. Among the 17 participants who reported that their facility provided this service, the majority (10/17) reported no change in the way services were provided due to COVID-19. They continued to normally offer minor surgery services. However, they did notice a decrease of cases for the same reasons mentioned above under child health services. Eight of 17 participants observed no changes regarding referral due to the COVID-19 outbreak, while nine respondents mentioned an increase in number of cases referred who were suspected to have COVID-19. Because of the lack of emergency care, four HCWs reported a decrease in the number of referral cases at the facilities of Malimaka, Pata, Bede Combattant and Castors.

Maternal, sexual and reproductive health

Nineteen participants responded to the questions about labor and delivery services with varied responses. Deliveries were not conducted in two facilities, Henri Dunand and Notre Dame de Fatima, in our sample. Seventeen respondents reported that their facility provided this health care service. The majority (10) reported no changes in their facility. Other respondents reported changes in practice, specifically a decline in deliveries in their facility. They believed that many pregnant women gave birth at home. Fear of being infected with COVID-19 was reported as the main cause of the decrease in number of maternal deliveries.

Antenatal and postnatal services was discussed by 19 HCWs. Among them, eight reported no change in the provision of antenatal and postnatal care. Seven respondents reported drops in the number of consultations due to the refusal of women to be vaccinated against COVID-19 and stockouts of usually free medicines and consumables (e.g., needles, compresses, syringes, bandages). Furthermore, it was reported that the duration of visits and the weekly frequency the service was provided was decreased (from 3 days to 1 day per week) to respect physical distancing measures and due to reduced human resource availability.

The health facility "Notre Dame de Fatima", as a confessional hospital, did not provide sexual and reproductive health services. All other facilities provided family planning products. Respondents declared no change in activities in seven health facilities. The medical health district officer in Bimbo reported an increase in demand for contraception products, possibly due to the lockdown. She believed that lockdowns increased the frequency of sexual activity and women requested contraception to prevent unwanted pregnancies. Respondents from other health facilities in Bimbo district declared that there was a drop in contraceptive distribution due to the two main causes that have been mentioned. Conversely, some mentioned that numbers were reduced in their facilities due to people fearing to be infected with COVID-19 by going to the health facility while collecting the drugs, and due to a shortage of contraceptive products because of the closure of the borders.

Immunization services

Six respondents reported no change in immunization activities in their health facilities. However, there was a drop in vaccination coverage according to 12 other respondents due to fears linked to the COVID-19 vaccine. Occurrence of violence against vaccinators engaged in child vaccination campaigns was also reported; some were badly received, even attacked by the population at the beginning of the COVID-19 pandemic.

Laboratory and pharmacy

Only few of the visited facilities had a functional biomedical analysis laboratory. Several laboratories acquired the capacity to perform COVID-19 rapid tests and to take samples and test for PCR. Training for technicians occurred. Nonetheless, some respondents declared the number of daily laboratory analyses decreased since the beginning of the COVID-19 pandemic. Analyses were often done after patients' visits. As there was a decrease in consultations, the number of daily laboratory tests also decreased.

Sixteen participants responded to questions concerning pharmacy activities in their health facility, and six respondents observed no change. The main impact of COVID-19 on the pharmacy activity was the reported drug stockout due the border closure which interrupted the supply chain. Activity of pharmacy also decreased due to the absence of donation from partners. One health facility (Notre Dame de Fatima) reported re-opening their pharmacy during COVID-19.

Hygiene practices in the facilities

The changes in hygiene practices varied according to health facilities. HCWs reported no change in hygiene practices in eight health facilities. In other facilities, the frequency of cleaning increased from 1 to 2-3 times per day. For example, in health facility "Le Peuple", they recruited a cleaning agent who was specifically in charge of cleaning the facility. The facilities were regularly equipped with hygiene materials, and handwashing points were increased at the beginning of the pandemic. However, as the months went by, materials were no longer renewed, and they noted shortages.

Community outreach

The Pata Health facility did not provide community health promotion activities. Nine respondents reported no change in community outreach. In other facilities, many community health workers were recruited to sensitize the community about preventative measures and to strengthen their awareness of the COVID-19 pandemic. Some reported that this emphasis had a negative impact on other community activities because everything was focused on COVID-19 prevention and care activities. They stated that the number of sensitizations on prevention of other diseases decreased.

Table 26: Summary of reported changes and causes by health service during COVID-19 in CAR

Health care services	No change (# of respondents)	Changes	Reasons
Curative care	3	• Decrease in number of consultations • Long waiting time	• Fear of being infected with COVID-19 • Reorganization of preventive and health care services • Respect to preventive measures

Treatment of chronic diseases	7	• Decrease in number of consultations • Interruption of health care service	• Fear of being infected with COVID-19 • Confirmed COVID-19 case among HCWs • Lack of diagnostic equipment
Integrated Management of Childhood Illness	7	• Decrease in number of consultations • Reduction of HCWs	• Fear of being infected with COVID-19 • Respect of preventive measures • Decrease in number of parents visits
Integrated Management of acute malnutrition	8	• Decrease in number of consultations • Reduction of HCWs	• Fear of being infected with COVID-19 • Respect to the barrier's measures • Decrease in number of parents visits • Reduction of frequency of consultations per week
Minor surgery	10	• Decrease in number of cases	• Fear of being infected with COVID-19 • Electoral violence
Referral cases	8	• Decrease in number of cases • Increase in number of cases	• Fear of being infected with COVID-19 • Lack of emergency care • Many suspected cases of COVID-19 referred
Labor and Delivery	10	• Decrease in number of deliveries	• Fear of being contaminated with COVID-19 • Refusal to respect preventative measures
Antenatal and postnatal care	8	• Decrease in number of consultations • Refusal of women to be vaccinated • Stockout of (free) medicines and consumables	• Fear of being contaminated with COVID-19 • Absence of partners • Reduction of duration and frequency of consultations per week
Sexual and reproductive health (Family planning)	7	• Decrease in number of consultations • Contraception product stockout • Increase in number of consultations	• Fear of being contaminated with COVID-19 • Closure of borders • Effect of lockdown
Immunization	6	• Drop in vaccination coverage • Poor welcome by population • Aggression of vaccinators	• Fear of being contaminated with COVID-19 • Lack of trust in vaccination
Laboratory	9	• Capacity to do COVID-19 rapid test • Capacity to collect sample for RT-PCR	• Fear of being contaminated with COVID-19 • Decrease in number of consultations • Lack of materials

		• Drop in number of daily laboratory tests done	
Pharmacy	6	• Medicines stockout • Decrease in number of medicines delivered • New health service created	• Absence of donation from partners • Closure of borders • Interruption of supply chain
Hygiene	8	• Recruitment of a cleaning agent • Increase in frequency of health facility cleaning • Equipment with hygiene materials • Installation of hand washing devices	• Respect of preventative measures • Protection against COVID-19 • Compliance with preventative measures
Community activity	9	• Sensitize the community on the respect of preventative measures • Strengthen awareness of the COVID-19 pandemic	• Respect of preventative measures • Prevention of COVID-19

4.3.5 Management of human, material, and financial resources

HCWs reported that many resources were redirected towards the implementation of preventative measures related to COVID-19. At the same time, however, the drop in consultations led to a decrease in revenue in the facilities. Some facilities also reported that external financial support by NGOs was interrupted.

In terms of human resources, some HCWs were reassigned to positions specifically created for the management of COVID-19 cases. Other respondents reported the termination of HCWs contracts due to the lack of financial resources and absence of donations from partners.

Trainings on COVID-19 prevention and treatment were organized, often at the expense of already planned trainings on other subjects.

Bangui 3 health district experienced several simultaneous cases of COVID-19 among HCWs. This led to reduced human resources availability that affected the delivery of health services. Respondents also reported delays in transmission of monthly reports because some HCWs in charge of reports were mobilized for COVID-19 activities.

A few respondents noted that collaboration between health facilities and the health district office had been reinforced due to the increased number of meetings and exchanges between them.

Table 27: Summary of reported changes related to the management of health care services during COVID-19 in CAR

Health care services	No change (number of respondents)	Change	Reasons
Human resources	11	• Capacity building on COVID-19 prevention and treatment • Recruitment of one cleaning agent in one health facility • Task shifting • Absence of training session on other diseases • Interruption of activities • Better collaboration between different level in health system	• Compliance with preventive measures • Reorganization of preventative and curative and health care services • HCWs fall sick • Termination of work contracts
Financial resources	4	• Drop of revenue	• Drop of consultations • Interruption of support by partners
Equipment	4	• Setting up of handwashing stations • Provision of hygiene material • Creation of COVID-19 ward • Lack of other equipment • Delay in transmission of monthly reports	• Compliance with barriers measures • Break of supply chain

4.3.6 Summary of health care workers' perceptions

At the beginning of the crisis, respondents were apprehensive about COVID-19. Over time and due to trainings, they understood the need to adapt their behavior in the face of the crisis and accepted to implement preventive measures in their facilities. Difficulties in implementation were due to disruptions in supplies which affected the HCWs' motivation. According to the HCWs, these response measures were effective and helped them acquire good practices in hygiene and fight against nosocomial infections. Five respondents reported an improvement in quality of care related to increased awareness about hospital hygiene, better triage of patients and improved waste management.

HCWs regretted that resources were redirected towards COVID-19 interventions at the detriment of other diseases.

When asked about which population groups they considered most affected, responses varied. Some respondents thought it was mainly children because of the drop in vaccination. Others believed it was the elderly with comorbidities. The latter could not attend facilities because of the risk of infection, and consequently did not benefit from the management of chronic diseases.

All these changes required adaptation, a change in behavior and adherence by the population. Some people continued to be afraid of COVID-19 and still believed that there was a high risk of being infected in the hospital. But with awareness, they appreciated the efforts made by the authorities and the HCWs to meet their needs.

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

- About half of the respondents are well or very well informed about who is most susceptible and about measures that can be taken to reduce the risk of contracting COVID-19:
    - No consistent difference among age groups in terms of knowledge.
    - No difference between sex.
    - Displaced and rural groups often less informed than non-displaced and urban.
- Concept of asymptomatic cases is not well understood.

Knowledge and reported practice of preventative measure

- Knowledge is high and reported measures are correct: wearing a mask, hand washing, avoid hand shaking, hugging, reduce contact with others.
- Reported practice is also quite high: more than half of the respondents report wearing mask, maintain physical distance, wash hand. Rural respondents mentioned any of the measures less frequently than urban respondents.
- Challenges to implementing protective measures include financial and practical barriers, personal (difficulty to breathe) and social (wearing a mask was negatively perceived).
- Lack of consultation was reported by community members who had wished to be involved in the decisions of introducing such measures.

Information sources

- Radio is main source of information, and it is also the most trusted source.
- Other sources such as health workers, social network, TV and NGOs were reported by only 8% of the respondents.
- One fifth of the respondents reported trusting information coming from their close circle.
- Two rumors were circulating despite access to information:
    - The existence of COVID-19 was questioned, as it was perceived as a “white people disease” or a manipulation by the government.
    - Treatment and prevention measures were stated to include the bark of a tree, a local alcoholic drink, herbal tea, staying in the sun and praying.

Vaccination

- 3/4 of the respondents were willing to be vaccinated (probably or very probably).
    - Similar answers between sex and age groups.
    - More displaced than non-displaced, and more persons in Bangui and Bimbo than Bégoua.
    - 10% certainly against and 7% uncertain.
- Respondents seemed to differentiate between routine child vaccines (which they trust) and COVID-19 vaccine (which they do not trust completely).
- Reasons for not trusting the COVID-19 vaccine:
    - Race ("A disease the western want to share with us"; "This vaccine is for white people"; "Plot of the white man to kill black people").
    - Fear of secondary effects.
    - Rumors ("The vaccine will contaminate people"; sterility).

Health care seeking behavior

- Most of the respondents did not report experiencing an episode of illness during the first months of COVID-19 restrictions.
- Among those who did, the majority sought care. The majority of the respondents who sought care, went to a hospital.
- Most of the respondents who did not seek care reported this being due to financial barriers, especially among female headed households and displaced people.
- Fear of testing positive with COVID-19 and having to comply with related restrictions was a major deterrent to utilizing health care reported in FGDs.
- Lack of medicine and of qualified personnel were also mentioned in FGD as reasons for not seeking care.
- Most of the respondents reported they vaccinated their children. This is consistent across age groups, sex, residence, displacement status.
- Interruption of services and fear of COVID-19 infection were the two most reported reasons among those respondents who did not vaccinate their children.

Access to WASH

- Half of the population has access to improved hand washing facilities at home, and some more in the community.
- One third of the respondents does not have access to hand washing facility, mainly due to lack of financial means as water and soap are too expensive.
- Most of the hand washing stations were not available before COVID-19.

Social interactions

- Changes in behaviors were reported during the first months of COVID-19 restrictions: frequency and duration of meetings decreased for the majority of respondents, while a third mentioned that they stopped all meetings outside the households.
- Interactions were mainly with other adults, in homes, and outdoor. Most interactions lasted between 15 minutes and one hour.
- Masks were not worn.

4.4.2 Respondents profile

Table 28 include overall characteristics of survey respondents. Most respondents were women (63%) in the age group 30 to 59 years (61%), non-displaced (82%), Christian (88%) and mainly working in small commerce or agriculture. Forty six percent (46%) of the respondents had secondary level education (mainly in Bangui), and one third at the primary level.

4.4.3 General knowledge about COVID-19

Quantitative results

Table 29 shows descriptive statistics about general knowledge of COVID-19. Most of the respondents had heard of COVID-19 by the time of the survey. Two (2) % of the respondents in Bégoua reported not having heard of it. Most of the respondents (64%) believed that everybody with COVID-19 would show signs and symptoms.

When asked about who is most susceptible to falling ill (table 30), half of the respondents were either well informed or informed. The elderly were better informed than respondents in the younger groups (71% of respondents 60+ were either well informed or informed vs 49% and 47% among the 18-29 and 30-59 respectively). Men and women were similarly informed, while non-displaced were better informed than displaced respondents: 46% of the non-displaced were not at all informed versus 73% among the displaced. A higher proportion of respondents from Bangui (21%) compared to Bégoua (3%) and Bimbo (8%) were classified as well informed. This is reflected also in the higher proportion of respondents from urban areas classified as well informed (17%) vs rural (8%). The majority of the respondents (57%) were classified as either well informed or informed with regard to the possibility to take measures to reduce the risk of contracting COVID-19 (table 30). Respondents in the elderly group were less informed than respondents from younger groups (46% in the 60+ vs 61% and 55% in the 30-59 and 18-29 respectively). Displaced, urban and respondents from Bangui were slightly better informed than non-displaced, rural and respondents from other districts. Respondents were very well informed about ways how a person can contract COVID-19 (table 30): 98% of them were either well informed or informed. Responses were similar across age groups and between sex. A smaller proportion of displaced respondents (36%) was classified as “well informed” than among non-displaced (48%). A much higher proportion of respondents from Bangui (63%) was well informed than among respondents from Bégoua (6%) and Bimbo (16%). Half of the urban respondents were well informed, versus only 10% of the rural respondents. At an aggregated

level, 33% of the respondents were classified as well informed, and 67% as informed. Half of the respondents in the youngest group were well informed versus a fifth in the elderly. None of the respondents from both Bimbo and Bégoua was classified as well informed. Results from the logistic regression (table 31) do not identify clear risk or protective factors associated with higher levels of knowledge. Female-headed households and public officials/employee were associated with higher odds of being well informed compared to male-headed households and to respondents without employment.

Looking more specifically at each sub-question (tables 32 and 33), here key results:

- Across age groups, displacement status, sex and resident, the majority of respondents knew that the elderly were at highest risk of falling severely ill.
- Physical contact with an infected person and particles in the air were the two most reported ways how a person can contract COVID-19.
- Eating certain foods and drinking contaminated water was mentioned as an infection route by 14% and 13% of the respondents respectively.
- Washing in contaminated water was reported as transmission route by 19% of respondents in rural areas (28% in Bégoua and 26% in Bimbo).

Table 28: Household survey respondents characteristics, CAR

	Overall	Age of HoH (years)			Gender of HoH		Displacement status		Health district			Setting	
		18-29	30-59	60 +	F	M	Res	IDP	Bangui	Bégoua	Bimbo	Rural	Urban
1) Average persons surveyed per age													
What is the age of the surveyed person?													
Age of the respondent?	40	24	42	67	39	43	40	39	40	41	40	40	40
2) % persons surveyed per age category													
What is the age of the surveyed persons?													
30-59 years	61%	----	----	----	59%	66%	61%	69%	63%	73%	57%	63%	61%
18-29 years	27%	----	----	----	31%	19%	27%	25%	26%	21%	29%	26%	27%
60+ years	12%	----	----	----	10%	15%	12%	6%	12%	6%	14%	11%	12%
3) % of women surveyed per age category													
Age of women surveyed													
30-59 years	59%	----	100%	----	59%	----	59%	57%	60%	69%	54%	60%	59%
18-29 years	31%	100%	----	----	31%	----	31%	37%	30%	27%	35%	33%	31%
60+ years	10%	----	----	100%	10%	----	10%	6%	10%	4%	10%	7%	10%
4) % of men surveyed per age category													
Age of men surveyed													
30-59 years	66%	----	100%	----	----	66%	66%	88%	67%	77%	60%	67%	66%
18-29 years	19%	100%	----	----	----	19%	19%	5%	19%	14%	18%	16%	19%
60+ years	15%	----	----	100%	----	15%	15%	7%	14%	8%	21%	16%	15%
5) % people surveyed per sex													
What is the sex of the respondent?													
Woman	63%	74%	60%	52%	----	----	63%	62%	62%	56%	65%	58%	63%
Man	37%	26%	40%	48%	----	----	37%	38%	38%	44%	35%	42%	37%
6) % households by displacement status													
What is the displacement status of the household?													
Non-displaced (all)	82%	83%	80%	89%	82%	82%	----	----	76%	82%	100%	71%	100%
Displaced (all)	18%	17%	20%	11%	18%	18%	----	----	24%	18%	0%	29%	0%
7) % persons per religion													
What is your religion?													
Christian	88%	89%	86%	93%	90%	84%	88%	98%	90%	99%	81%	95%	87%
Muslim	6%	5%	8%	2%	5%	9%	6%	1%	9%	1%	1%	1%	7%
Animist	6%	6%	6%	5%	5%	7%	6%	1%	1%	----	18%	4%	6%

	Overall	Age of HoH (years)			Gender of HoH		Displacement status		Health district			Setting	
		18-29	30-59	60 +	F	M	Res	IDP	Bangui	Bégoua	Bimbo	Rural	Urban
Prefer not to respond	0%	----	0%	----	----	0%	0%	----	----	----	0%	0%	----
8) % households per type of activity													
Which sector do you work in?													
Small-scale commerce	31%	45%	28%	13%	44%	8%	31%	34%	37%	4%	19%	9%	33%
Agriculture or market-gardening and sale of agricultural produce	20%	12%	20%	32%	20%	19%	20%	20%	8%	80%	41%	74%	14%
Commerce	11%	10%	13%	5%	12%	10%	11%	7%	11%	8%	14%	4%	12%
None	10%	14%	7%	15%	12%	7%	10%	12%	12%	----	8%	2%	11%
Small-scale trades (carpentry, masonry, plumbing, tailoring, etc)	8%	4%	10%	5%	1%	19%	8%	5%	9%	2%	6%	3%	8%
Public officials or employees (including pensioners)	6%	1%	7%	16%	3%	12%	6%	2%	8%	2%	2%	1%	7%
Transport (driver, related activities)	3%	3%	4%	----	1%	8%	3%	2%	4%	1%	1%	1%	4%
Paid (in cash or in kind), non-agricultural day labour	3%	1%	4%	5%	3%	4%	3%	1%	4%	----	1%	0%	3%
Fishing/ hunting/ foraging and sale of fishing/ hunting/ foraging produce (honey, game, mushrooms, caterpillars)	3%	1%	3%	3%	1%	6%	2%	13%	1%	2%	5%	4%	2%
Other	2%	5%	1%	2%	3%	1%	2%	1%	3%	1%	1%	1%	2%
Livestock farming and sale of livestock and related produce (milk, eggs, poultry)	1%	1%	2%	2%	0%	3%	1%	1%	2%	1%	----	0%	2%
Paid (in cash or in kind), agricultural day labour	1%	1%	1%	----	1%	1%	1%	3%	0%	----	2%	0%	1%
Transformation of natural products/ exploitation and sale of mining produce	0%	1%	0%	0%	0%	1%	0%	----	1%	----	0%	1%	0%
Do not know / prefer not to respond	----	----	----	----	----	----	----	----	----	----	----	----	----
9) % persons per level of education													
What is the highest level of education that you have achieved?													
Secondary level	46%	59%	45%	28%	41%	55%	46%	35%	52%	30%	34%	30%	48%
Primary level	36%	32%	37%	37%	41%	27%	36%	48%	31%	52%	46%	54%	34%
None	11%	6%	11%	23%	15%	4%	11%	16%	9%	16%	16%	14%	11%
University level	7%	4%	8%	12%	3%	13%	7%	1%	8%	2%	4%	2%	8%
Do not know / prefer not to respond	----	----	----	----	----	----	----	----	----	----	----	----	----

Note: IDP= Internally displaced people; HoH: Head of Household

Table 29: General knowledge of COVID-19 among the respondents to the household survey, CAR

	Have you heard of COVID-19?		Does everyone who has COVID-19 show signs and symptoms?		
	Yes	No	Yes	No	DNK
Overall	100%	0%	64%	27%	10%
Age of Head of the Household (years)					
18-29	100%	0%	72%	22%	6%
30-59	99%	1%	61%	27%	12%
60 et plus	100%	0%	59%	32%	9%
Gender of Head of the Household					
Female	100%	0%	65%	27%	8%
Male	100%	0%	61%	26%	13%
Displacement Status					
Non-displaced	100%	0%	64%	27%	10%
Displaced	100%	0%	61%	23%	16%
Health District					
Bangui	100%	0%	70%	20%	9%
Bégoua	98%	2%	56%	14%	9%
Bimbo	99%	1%	48%	43%	9%
Setting					
Rural	99%	1%	59%	25%	15%
Urban	100%	0%	64%	27%	9%

Table 30: Level of knowledge about COVID-19 among respondents to the household survey, CAR

Categories: Well informed (4) / Informed (3) / A little informed (2) / Not at all informed (1)

	Who is the most susceptible to falling ill with COVID-19?				Is it possible to take measures to reduce the risk of contracting COVID-19?				How can a person contract COVID-19?				% of respondents who report being well informed on COVID-19			
	4	3	2	1	4	3	2	1	4	3	2	1	4	3	2	1
Overall	16%	34%	4%	46%	10%	47%	40%	2%	48%	48%	0%	4%	3%	33%	57%	7%
Age of HoH (years)																
18-29	17%	32%	4%	47%	13%	42%	43%	3%	49%	45%	0%	5%	4%	28%	58%	10%
30-59	16%	31%	4%	50%	10%	51%	37%	2%	49%	48%	0%	3%	2%	33%	58%	6%
60 +	19%	52%	2%	27%	5%	41%	51%	3%	40%	55%	0%	5%	2%	39%	51%	8%
Gender of HoH																
Female	16%	35%	4%	44%	11%	48%	39%	2%	47%	48%	0%	5%	3%	32%	56%	9%
Male	18%	30%	2%	50%	10%	46%	42%	2%	49%	49%	0%	2%	2%	33%	60%	5%
Displacement Status																
Non-displaced	16%	34%	4%	46%	10%	47%	40%	2%	48%	48%	0%	4%	3%	34%	56%	7%
Displaced	17%	7%	3%	73%	16%	47%	35%	3%	36%	54%	0%	7%	4%	27%	63%	6%
Health District																
Bangui	21%	32%	1%	46%	15%	40%	44%	1%	63%	37%	0%	0%	7%	40%	52%	1%
Bégoua	3%	25%	4%	68%	2%	60%	25%	14%	6%	84%	0%	10%	0%	25%	58%	17%
Bimbo	8%	40%	9%	44%	1%	64%	32%	4%	16%	72%	0%	11%	0%	27%	64%	9%
Setting																
Rural	8%	31%	4%	57%	1%	53%	35%	10%	10%	79%	0%	11%	0%	27%	60%	13%
Urban	17%	34%	3%	45%	11%	47%	41%	1%	51%	45%	0%	3%	5%	36%	56%	3%

Note: HoH: Head of Household

Table 31: Factors associated with knowledge related to COVID-19

N=1045	Odds ratio	Confidence interval	pvalue
Age (ref 18-29)			
30-59	1.018575	.7480627 - 1.386909	0.906
60 +	1.268359	.808875 - 1.988854	0.297
Displacement Status (ref residents)			
Displaced	.7325298	.3234078 - 1.659205	0.452
Sex (ref male)			
Female	**1.711668**	1.128483 - 2.596236	0.012
Religion (ref animist)			
Christian	.9665194	.5616703 - 1.663182	0.901
Muslim	.9554459	.4222412 - 2.16198	0.912
Education (ref none)			
Primary	.5923803	.3286195 - 1.067844	0.081
Secondary	1.349686	.7457295 - 2.442779	0.319
University	1.989147	.7905073 - 5.005274	0.142
Setting (ref urban)			
Rural	.85642	.4954248 - 1.480457	0.576
Profession (ref none)			
Trade	.9593247	.4932314 - 1.865866	0.902
Agriculture	1.182732	.608912 - 2.297302	0.617
Public official/ employee	**2.680641**	1.264566 - 5.682453	0.011
Other	1.577921	1.050914 - 2.369207	0.028
Health District (ref Bangui)			
Bégoua	.4603798	.2074239 - 1.021818	0.056
Bimbo	.7280648	.4325663 - 1.225427	0.230

Table 32: Who is the most susceptible to falling severely ill because of COVID?

	Elderly People (60+ yrs)	Everyone	Adults (19-59 yrs)	People with pre-existing conditions	Health Workers	Children (0-18 yrs)	Pregnant or Nursing women	Other	Prefer not to respond/ Don't know
Overall	50%	44%	22%	17%	18%	7%	6%	2%	2%
Age of HoH									
18-29	48%	45%	24%	18%	8%	4%	9%	1%	1%
30-59	47%	48%	19%	16%	8%	9%	4%	2%	1%
60 +	71%	23%	29%	19%	7%	5%	7%	3%	4%
Gender of HoH									
Female	51%	42%	24%	16%	8%	8%	7%	1%	2%
Male	48%	48%	18%	18%	8%	5%	4%	4%	1%
Displacement Status									
Non-displaced	50%	44%	22%	17%	8%	7%	6%	2%	2%
Displaced	24%	71%	8%	17%	9%	3%	7%	1%	2%
Health District									
Bangui	52%	45%	24%	21%	10%	5%	4%	2%	1%
Bégoua	28%	55%	16%	3%	2%	13%	1%	0%	12%
Bimbo	47%	41%	18%	9%	4%	10%	10%	2%	2%
Setting									
Rural	39%	47%	14%	9%	1%	7%	2%	3%	8%
Urban	51%	44%	22%	18%	8%	7%	46%	2%	1%

Note: HoH: Head of Household

Table 33: How can a person contract COVID-19?

	Physical contact with infected person	Particles in the air	Physical contact with contaminated object or surface	Washing in contaminate water	Eating certain foods	Drinking contaminated water	Contaminated breastmilk	Other	Prefer not to respond/Don't know
Overall	84%	82%	61%	14%	14%	13%	6%	7%	1%
Age of HoH (years)									
18-29	79%	85%	59%	17%	16%	22%	8%	9%	1%
30-59	87%	83%	62%	14%	13%	10%	4%	5%	1%
60 +	84%	70%	62%	10%	14%	8%	8%	9%	4%
Gender of HoH									
Female	84%	82%	57%	16%	14%	14%	6%	6%	2%
Male	84%	83%	68%	10%	13%	11%	4%	7%	1%
Displacement Status									
Non-displaced	84%	82%	61%	14%	14%	13%	6%	7%	1%
Displaced	69%	80%	61%	18%	10%	14%	6%	4%	3%
Health District									
Bangui	93%	90%	74%	9%	8%	14%	7%	6%	0%
Bégoua	40%	81%	14%	28%	24%	16%	0%	3%	9%
Bimbo	68%	63%	35%	26%	26%	11%	4%	8%	3%
Setting									
Rural	51%	75%	26%	19%	18%	7%	1%	4%	6%
Urban	87%	83%	65%	14%	13%	13%	6%	7%	1%

Note: HoH: Head of Household

4.4.4 Knowledge and reported practice of preventative measures

Quantitative results

All respondents knew that there are measures that can be taken to reduce the risk of being infected (table 34). The lowest proportion of respondents aware of the existence of such measures was 90% among rural respondents. When asked about the specific measures to take (table 34), the most reported measures (>70%) include: wearing a mask, hand washing, stop shaking hands and hugging. Reduce contact with others was mentioned by 58% of the respondents and increasing distance by 39%. Praying was indicated by 14% of respondents. Proportion of respondents mentioning each measure was lower among rural than among urban respondents.

When asked whether they practice a certain measure (table 35), 62% of the respondents say they wear a mask in public; 52% try to maintain physical distance; and 66% wash their hands. More respondents among the elderly reported wearing a mask (74%) than among respondents in younger groups (63% in the 18-29 and 60% in the 30-59 age groups); more respondents among non-displaced (62%) than displaced (42%). Responses are more similar across groups with regard to physical distance and hand washing. No clear differences between respondents from female-headed and male-headed households, and across age groups. Older age, residence in Bimbo and higher levels of knowledge were positively associated with higher odds of reporting wearing a mask. Displaced respondents, Christian religion, and working in agriculture were associated with lower odds of reporting wearing the mask. With regard to factors associated with reporting washing hands, working in agriculture, Muslim religion, and higher levels of COVID-19 related knowledge are negatively associated with hand washing (table 36).

Qualitative results

Knowledge of preventative measures (such as nose covering, hand washing, physical distancing) is widely spread among community members, however implementation varies. Preventative measures were initially followed by the majority of the population, but this has changed over time. Preventative measures were mostly “no longer” implemented at the time of data collection, either because of a perceived reduced risk or because of the arrival of vaccines (one FGD). Yet, some behaviors such as regular hand washing and reduced physical contact/handshaking seem to have been maintained in current daily life.

Participants reported 3 main types of difficulties regarding implementing preventative measures:

- Financial and practical constraints: unavailability of masks or handwashing kits due to financial difficulties to buy them.
- Personal: difficulty to breath with masks (Bégoua, Bimbo).
- Social (more prominent in the more rural health districts of Bégoua and Bimbo):
    - Some participants mentioned that wearing a mask was negatively perceived (people wearing masks were considered arrogant and treated disrespectfully.
    - Social distancing was difficult to respect, especially inside the family circle (for example, with partner; or between mother and child).

Furthermore, participants complained about the lack of community involvement in the decision to introduce such measures. FGD participants from the three districts lamented not being consulted and wished local community leaders had been involved to ensure population satisfaction. Some participants from Bégoua and Bimbo considered the measures unfair and discriminatory.

Relevant Quotes:

"Pendant la période de la pandémie de COVID-19... Les gens ne mangent pas ni boivent pas dans le même gobelet ou même assiette que quelqu'un a déjà utilisé; Les gens restes en distance entre eux ... Les gens ne s'approchent pas les personnes malades surtout ceux qui présentent les symptômes de grippe ; Les gens se saluent qu'en coude de main ; Les gens portent les caches nez ...."

EN: "During the COVID-19 pandemic... people don't eat or drink from the same cup or plate that someone has already used, people keep distance from one another... people don't go close to sick people especially those who present flu symptoms, people only greet each other with the elbow, people wear masks..."

FGD mixed +60, IDPs Bangui.

Table 34: Knowledge about preventive measures among respondents to the household survey, CAR

	% of respondents who think it is possible to take measures to reduce the risk of contracting COVID-19	If yes, how to do you reduce the risk of contracting COVID-19?									
		Wear a mask	Hand washing	Stop shaking hands/ hugging	Reduce contact with others (avoiding crowds, stay at home)	Increase the distance between oneself and others	Disinfect and/or clean objects and surfaces	Wear gloves	Pray	Other	Do not know/no response
Overall	98%	86%	86%	73%	58%	39%	26%	16%	14%	2%	0%
Age of HoH (yrs)											
18-29	97%	93%	86%	75%	64%	42%	30%	22%	14%	1%	0%
30-59	98%	84%	85%	73%	55%	41%	25%	14%	9%	3%	0%
60 plus	97%	84%	89%	66%	63%	25%	21%	17%	9%	0%	0%
Gender of HoH											
Female	98%	85%	85%	73%	59%	40%	24%	17%	10%	1%	0%
Male	98%	88%	87%	72%	57%	38%	28%	15%	10%	3%	0%
Displacement Status											
Non-displaced	98%	86%	86%	73%	58%	39%	26%	16%	10%	2%	0%
Displaced	97%	78%	85%	66%	57%	44%	26%	12%	7%	1%	1%
Health District											
Bangui	99%	91%	92%	77%	69%	41%	33%	22%	12%	2%	0%
Bégoua	86%	61%	69%	50%	37%	60%	3%	5%	9%	10%	0%
Bimbo	96%	78%	71%	64%	35%	33%	4%	3%	8%	3%	0%
Setting											
Rural	90%	67%	74%	61%	43%	38%	4%	3%	8%	3%	0%
Urban	99%	88%	87%	74%	60%	39%	27%	17%	11%	2%	0%

Note: HoH: Head of Household

Table 35: Reported practice of preventive measures among respondents to the household survey, CAR

	Do you wear a mask when you go out in public?			Do you try to maintain physical distance in public?			Do you wash your hands with soap and water?		
	Yes	No	Do not wish to respond	Yes	No	Do not wish to respond	Yes	No	Do not wish to respond
Overall	62%	38%	0%	52%	48%	0%	66%	34%	0%
Age of HoH									
18-29	63%	37%	0%	58%	42%	0%	61%	39%	0%
30-59	60%	40%	0%	52%	48%	0%	68%	32%	0%
60 +	74%	26%	0%	42%	58%	0%	64%	36%	0%
Gender of HoH									
Female	65%	35%	0%	51%	40%	0%	63%	37%	0%
Male	57%	43%	0%	55%	45%	0%	69%	30%	1%
Displacement Status									
Non-displaced	62%	38%	0%	52%	48%	0%	66%	34%	1%
Displaced	42%	58%	0%	61%	39%	0%	65%	35%	0%
Health District									
Bangui	61%	39%	0%	53%	47%	0%	63%	36%	0%
Bégoua	56%	44%	0%	49%	51%	0%	38%	61%	1%
Bimbo	67%	33%	0%	50%	50%	0%	74%	26%	0%
Setting									
Rural	56%	43%	1%	56%	44%	0%	59%	41%	1%
Urban	63%	37%	0%	52%	48%	0%	66%	24%	0%

Note: HoH: Head of Household

Table 36: Factors associated with reported preventative measures: wearing a mask and washing hands

	Reported wearing of masks (N=1043)			Reported hand washing (N=1042)		
	Odds ratio	**Confidence interval**	**pvalue**	**Odds ratio**	**Confidence interval**	**pvalue**
Age (ref 18-29)						
30-59	.9649474	.7139859 1.30412	0.815	1.498101	.8972639 2.501277	0.121
60 +	**1.694844**	1.058378 2.714055	0.028	1.095585	.5584424 2.149382	0.789
Displacement Status (ref residents)						
Displaced	**.51683**	.3602551 .7414557	0.000	.9396667	.6381097 1.383733	0.750
Sex (ref male)						
Female	1.515325	.9413726 2.439215	0.086	.6816458	.3141865 1.47887	0.329
Religion (ref animist)						
Christian	**.36101**	.1580671 .8245119	0.016	.1552839	.0186061 1.295976	0.085
Muslim	.5132844	.1300619 2.025657	0.338	**.0780087**	.0091313 .6664265	0.020
Education (ref none)						
Primary	1.020706	.5387933 1.933656	0.949	.6390111	.3351741 1.218278	0.172
Secondary	1.066962	.5687917 2.001449	0.839	.8854157	.4588924 1.708376	0.714
University	.822596	.3252081 2.080711	0.677	.8821029	.3427442 2.270222	0.793
Setting (ref urban)						
Rural	.7967388	.4654776 1.363745	0.404	1.083605	.529575 2.217251	0.824
Profession (ref none)						
Trade	.7228493	.3403443 1.535243	0.395	1.007971	.5495989 1.84863	0.979
Agriculture	**.5108083**	.2853521 .9143969	0.024	**.479725**	.2354442 .9774548	0.043
Public official/ employee	1.447498	.5328155 3.932413	0.465	.4700258	.150564 1.467311	0.191
Other	.6284868	.2966714 1.331425	0.223	.9941321	.3874071 2.55106	0.990
Health District (ref Bangui)						
Bégoua	2.165349	.9232099 5.078733	0.075	.3711667	.1223336 1.126139	0.080
Bimbo	**1.838737**	1.25442 2.695232	0.002	1.422055	.7720852 2.619195	0.256
Knowledge of Covid-19 (ref not informed)						
Partially Informed	**2.206918**	1.229062 3.962769	0.009	.7104084	.3423934 1.473977	0.355
Informed	**4.469831**	2.433883 8.208852	0.000	.5192669	.2482781 1.086032	0.081
Well Informed	**4.522213**	1.147715 17.81837	0.031	**.0436082**	.013435 .1415466	0.000

4.4.5 Information sources

Quantitative results

The main source of information is the radio which was reported by 67% of respondents (table 37). Responses are similar across age groups, sex of the head of the household, displacement status. Less respondents in Bimbo (58%) reported radio as the primary source than in Bégoua and Bangui (71% each). In Bimbo more respondents rely on NGOs and community/religious leaders than in Bangui. Other sources such as health workers, social networks, TV, NGOs, were mentioned by less than 8% of the respondents.

Radio is also the most trusted source of information (61% of respondents), followed by HCWs (13%). In Bimbo, less than half of the respondents ranked radio as the most trustworthy source of information. 19% reported trusting information coming from their close circle.

Qualitative results

All focus groups have mentioned the radio as one of the main sources of information, followed by international and national NGOs, religious and traditional leaders, and health workers.

In general, sources seem to be trusted however some respondents reported mistrust about the number of deaths, as they had not seen any casualties in their community. Some respondents from Bégoua complained about the lack of reporting the number of cases and deaths, feeling the information provided is not fully useful. Absence of a local radio station or receiver was mentioned as the main barrier to access information. Interruption of electricity and lack of radio were reported as well.

Participants recognized that despite the access to information, rumors were spreading across the community. Rumors were mainly around two topics: first, the overall existence of COVID-19. Some community members believed COVID-19 was a “white people disease” or that it was a governmental manipulation. Second, prevention and treatment of COVID-19: a local alcoholic drink (ngouli) or the bark of a tree called ANDENGOU are presented as cure for COVID-19. Participants from focus groups in Bimbo mentioned rumors suggesting that herbal teas with bitter root and other natural remedies could prevent COVID-19, as well as staying in the sun or trusting God. Respondents however seemed to recognize that these were rumors and reported trusting only information from health workers.

Relevant Quotes:

« Les ONG ont rassuré la population de l’existence réelle de COVID-19. »
EN: "The NGOs convinced the population of the reality of COVID-19".
FGD male, 31-59, Bégoua

"Les radios donnent des informations sur la COVID-19, mais malheureusement elles ne donnent pas les informations détaillées."
EN: "Radios provide information about COVID-19, but unfortunately they don't provide detailed information."
FGD men 18 - 30, Bimbo

"L'antenne radio ne capte pas bien ici dans notre village, pour écouter de l'information il faut qu'on attache les antennes de nos radios sur un bambou de chine à une hauteur élevée, mais malgré tout ça la fréquence ne capte pas bien, il y'a beaucoup de saturation et la radio n'émet qu'à certaines heures."

EN: "The radio antenna doesn't receive well in our village, to listen to information we have to attach our radio receivers high up, attached to bamboo canes but despite that the frequency isn't received well, there's a lots of saturation and the radio only emits at certain times".

FGD men 31-59, Bégoua

"On prépare des tisanes pour prendre contre la maladie de COVID, certaines personnes disent qu'il faut consommer de l'alcool de haut degré, et d'autres personnes disent que la consommation de tabac aussi détruit la COVID."

EN: "We prepare herbal teas to take for COVID-19, some people say that you have to consume strong alcohol, others say that tobacco consumption also destroys COVID-19"

FGD mixed, +60, IDPs, Bangui

Table 37: Sources of information reported by the respondents to the household survey, CAR

How do you currently obtain most of your information concerning COVID-19?											
	Radio	Via health workers in medical establishments	Close circle	Social networks	TV	NGO	Religious/ community leaders	Door-to-doo health worker campaigns	Newspaper	Other	Prefer not to respond
Overall	67%	8%	6%	5%	4%	4%	3%	3%	0%	0%	0%
Age of HoH											
18-29	64%	7%	9%	4%	7%	3%	2%	3%	0%	0%	0%
30-59	67%	9%	5%	6%	4%	4%	2%	3%	0%	0%	0%
60 +	73%	3%	7%	2%	2%	2%	9%	3%	0%	0%	0%
Gender of HoH											
Female	68%	9%	8%	3%	4%	2%	3%	4%	0%	0%	0%
Male	66%	6%	4%	9%	5%	6%	3%	2%	0%	0%	0%
Displacement Status											
Non-displaced	67%	8%	6%	5%	4%	4%	3%	3%	0%	0%	0%
Displaced	70%	3%	16%	2%	1%	3%	1%	4%	1%	0%	0%
Health District											
Bangui	71%	8%	4%	7%	6%	1%	1%	3%	0%	0%	0%
Bégoua	71%	5%	10%	1%	0%	1%	8%	2%	1%	1%	1%
Bimbo	58%	7%	12%	1%	1%	11%	7%	3%	0%	0%	0%
Setting											
Rural	65%	6%	13%	0%	0%	2%	10%	3%	0%	1%	0%
Urban	68%	8%	6%	5%	5%	4%	2%	3%	0%	0%	0%

Note: HoH: Head of Household

Table 38: Which sources do you trust?

	What information source do you consider the most trustworthy for obtaining information about COVID-19?										
	Radio	Via health workers in medical Establishments	Close circle	Social networks	TV	NGO	Religious/community leaders	Door-to-doo health worker campaigns	Newspaper	Other	Prefer not to respond
Overall	61%	13%	6%	6%	5%	4%	3%	1%	0%	0%	0%
Age of HoH											
18-29	63%	14%	5%	7%	3%	4%	2%	2%	0%	0%	0%
30-59	59%	14%	7%	6%	5%	3%	4%	1%	0%	0%	0%
60 +	68%	10%	5%	2%	6%	9%	0%	0%	0%	0%	0%
Gender of HoH											
Female	60%	15%	7%	4%	5%	5%	3%	1%	0%	0%	0%
Male	64%	11%	5%	8%	5%	2%	2%	2%	0%	0%	0%
Displacement Status											
Non-displaced	61%	13%	6%	6%	5%	4%	3%	1%	0%	0%	0%
Displaced	62%	16%	5%	1%	3%	6%	6%	1%	1%	0%	0%
Health District											
Bangui	67%	14%	1%	8%	3%	3%	3%	0%	0%	0%	0%
Bégoua	73%	2%	1%	3%	7%	8%	2%	1%	1%	1%	1%
Bimbo	46%	13%	19%	1%	8%	6%	2%	3%	0%	1%	0%
Setting											
Rural	60%	10%	6%	2%	11%	7%	3%	1%	1%	0%	0%
Urban	61%	14%	6%	6%	4%	4%	3%	1%	0%	0%	0%

Note: HoH: Head of Household

4.4.6 Vaccination

Quantitative results: willingness to be vaccinated

Table 39 shows results related to the willingness of the respondents to be vaccinated. One third responded that they would very probably be vaccinated if a vaccine was available to the population. An additional 44% responded with "probably", leading to the ¾ of the population being likely to get vaccinated. Responses were similar across population groups and gender of the head of the household. More displaced than non-displaced respondents are willing to be vaccinated, and many more people in Bangui and Bimbo (33% and 34%) than in Bégoua (7%). 10% of the respondents was certain to refuse vaccination, twice as many among non-displaced (10%) than displaced (5%). 7% of the respondents was uncertain. Factors positively associated with higher willingness to be vaccinated include being internally displaced and living in rural areas (table 40).

Qualitative results: attitude towards vaccination

Most participants report trusting vaccines in general, and that most of the children in their communities are vaccinated. However, the same cannot be said for the COVID-19 vaccine.

Secondary effects are a strong cause of concern, including false effects (vaccine could prevent abortion, cause infertility or sexual impotence, and kill elderly people). Rumors were also reported pointing to the vaccine as a way to spread COVID-19 or other diseases that white people want to pass to African people ("*Selon les rumeurs, ce vaccin est pour les blancs, ils ont introduit des choses pour nous faire mal, donc on a le doute, il se pourrait qu'on peut etre infecter encore par d'autres virus*" FG9). Others think the vaccine will be "a way for Europeans to kill Africans" and "for the government to make money". The COVID-19 vaccine has also been described as a satanic sign.

Communities therefore wish to receive more information about side effects before being vaccinated.

Relevant Quotes:

"La première dose de vaccin de COVID a créé beaucoup de malaise chez des personnes qui l'ont fait, il a entrainé même la mort de certaines personnes. S'il y'a la possibilité, c'est mieux de diminuer la dose du vaccin et aussi de vérifier si celui qui veux se vacciner n'a pas autres maladie telle que diabète, hypertension, asthme qui pourrait compliquer d'avantage son état de santé après la vaccination, car y'avait un monsieur diabétique qui était allé faire le vaccin de COVID et une semaine plus tard il tombé dans un grave état mental et il était hospitalisé même à la psychiatrie."

EN: "The first dose of the COVID-19 vaccine created lots of discomfort for people who had it, it even led to the death of certain people. If it's possible, it's better to lessen the dose of the vaccine and also to check if those who want to be vaccinated don't have other illnesses such as diabetes, hypertension, asthma which could further complicate their health after vaccination, because there was a diabetic man who went to get the COVID vaccine and one week later he fell into a serious mental state and he was even hospitalized in a psychiatric ward.

FGD women 31 - 59, Bégoua

"*Les gens de notre communauté détestent c vaccin car pour eux, c'est une sorte de contamination facile"*

EN: "People in our community hate this vaccine because for them it's kind of easy contamination"

FGD women 31 - 59, Bégoua

"Nous venons de constater que le vaccin de COVID est arrivée dans le centre de santé qui se trouve à 3 km, mais malheureusement il n'y a pas eu une sensibilisation auprès de la communauté ce qui a fait que les ne ce sont pas allés massivement pour ce faire vacciner et le plus grave cette compagne de vaccination n'a pu durer plus de 2 jours dans la localité de DOMBE"

EN: "We have just seen that the COVID vaccine has arrived in the health center which is 3 km away, but unfortunately there has been no awareness raising with the community which has meant that people have not gone massively to get vaccinated and the most serious [is] this vaccination campaign could not last more than 2 days in the locality of DOMBE"

FGD men 31 - 59, Bégoua

"Le vaccin COVID-19 est porteur du virus, ce vaccin est ramener pour tué les africains"

EN: "The COVID-19 vaccine carries the virus, this vaccine is brought back to kill Africans"

FGD men 31 - 59, Bimbo

"Que cette maladie n'est pas beaucoup en République Centrafricaine, c'est aussi une manière de faire propager le virus"

EN: "That this disease is not very common in the Central African Republic, it is also a way of spreading the virus

FGD women 18 - 30, Bangui, IDPs

"Le vaccin COVID-19 tue les personnes de 3ème âge, c'est une stratégie des blancs pour tuer les noirs"

EN: COVID-19 vaccine kills 3rd age people, it's a strategy of whites to kill blacks

FGD mixed, 60+, Bangui, IDPs

"C'est un moyen pour propager le virus en Afrique; pour les religieux c'est une marque des bêtes Satanique et ceux qui ont des parents à l'extérieur leurs interdisent de ne pas se faire vacciner de peur d'être contaminer par le virus

EN: It's a way to spread the virus in Africa; for the religious it is a Satanic mark of the beasts and those who have parents outside forbid them not to be vaccinated for fear of being contaminated by the virus"

FGD men 31 - 59, Bangui

« Que c'est une manière de propager le virus en Afrique et aussi une marque diabolique"

EN: "That is a way of spreading the virus in Africa and also a diabolical mark"

FGD mixed, vulnerable community members, Bangui

"Que les Européens veulent tuer tous les Africains, que c'est la politique du gouvernement pour bouffer de l'argent"

That European want to kill all Africans, that it is the government policy to take up all the money"

FGD women 18 - 30, Bangui

Table 39: Willingness to get vaccinated among respondents to the household survey, CAR

If a vaccine was made available to the population, to what extent would you be prepared to get vaccinated?					
	Very Probably	Probably	Probably Not	Certainly Not	Uncertain/Neutral
Overall	32%	44%	7%	10%	7%
Age of HoH (yrs)					
18-29	34%	34%	9%	9%	5%
30-59	31%	31%	6%	11%	7%
60 +	37%	37%	6%	8%	8%
Gender of HoH					
Female	32%	32%	7%	11%	5%
Male	32%	32%	7%	9%	9%
Displacement Status					
Non-displaced	32%	32%	7%	10%	7%
Displaced	41%	41%	4%	5%	3%
Health District					
Bangui	33%	33%	6%	13%	6%
Bégoua	7%	7%	3%	2%	1%
Bimbo	34%	34%	9%	5%	10%
Setting					
Rural	25%	25%	4%	3%	3%
Urban	33%	33%	7%	11%	7%

Note: HoH: Head of Household

Table 40: Factors associated with willingness to be vaccinated against COVID-19

N=1045	Odds ratio	Confidence interval	pvalue
Age (ref 18-29)			
30-59	.7607583	.3723829 - 1.554189	0.450
60 +	1.039239	.4856906 - 2.223673	0.920
Displacement Status (ref residents)			
Displaced	**2.527754**	1.349129 - 4.736049	0.004
Sex (ref male)			
Female	1.107963	.6975282 - 1.759902	0.661
Religion (ref animist)			
Christian	.590771	.3451306 - 1.011241	0.055
Muslim	.5004634	.2345231 - 1.06797	0.073
Education (ref none)			
Primary	.951751	.5531472 - 1.637593	0.857
Secondary	.7820985	.3770449 - 1.622295	0.506
University	.4935983	.1275738 - 1.909792	0.303
Setting (ref urban)			
Rural	**2.754194**	1.563294 - 4.852308	0.001
Profession (ref none)			
Trade	1.282115	.6941048 - 2.368256	0.424
Agriculture	1.336207	.5973409 - 2.988993	0.477
Public official/ employee	2.080904	.901959 - 4.800842	0.085
Other	1.020406	.5731597 - 1.816646	0.945
Health District (ref Bangui)			
Bégoua	1.722675	.611749 - 4.851026	0.300
Bimbo	.7055633	.4180885 - 1.190704	0.189
Knowledge of Covid-19 (ref not informed)			
Partially Informed	**2.279714**	1.268218 - 4.097949	0.006
Informed	1.665828	.7893523 - 3.515519	0.178
Well Informed	.7989452	.140423 - 4.545648	0.798

4.4.7 Health care seeking behavior

Quantitative results

When asked about occurrence of illness events (table 41), 24% of households reported experiencing illnesses of any of the family members during the first months of COVID-19 restrictions. Almost twice as many households (42%) reported an illness event during the month before the survey. The majority of the households where one of the members was sick sought care in both periods, however a lower proportion sought care during the COVID-19 restriction months compared to during the month before the survey (61% vs 72%). In both periods, the proportion of people who sought care when sick was higher among the elderly than among younger respondents (72% vs 57% in the COVID-19 restriction months and 85% vs 70% during the month before the survey). More people among the non-displaced sought care than among the displaced (61% vs 31% in the COVID-19 restriction period and 72% vs 60% in the month preceding the survey). A higher proportion of respondents from rural areas than urban areas sought care during the first months of the COVID-19 restrictions, while this proportion was inverted the month preceding the survey.

Reasons for not seeking care preceding the survey included financial restrictions (87%), especially among female-headed households (94%) vs male headed (71%), displaced (93%) vs non-displaced people (87%), in Bimbo (98%) vs Bégoua (75%) and Bangui (79%). Additional reasons were related to the illness not considered serious enough (28%) and distance to health care provider (22%). Distance seems to be a bigger issue for non-displaced (22%) than for displaced respondents (7%). Lack of trust in health care providers was mentioned by 14% of the respondents (all non-displaced). Security reasons were rarely mentioned (2%), more in rural than in urban areas (7% vs 2%).

When investigating factors associated with seeking care (table 42), results need to be interpreted with caution as the absolute number of people seeking care and disaggregated by groups are relatively small (and confidence intervals very broad, especially for the COVID-19 restriction months). Higher levels of education seem associated with higher odds of seeking care (secondary level is the only statistically significant category). During the first months of the pandemic, respondents in Bégoua and Bimbo had higher odds to seek care than respondents in Bangui. Female respondents have higher odds of seeking care than male (statistically significant only for the results related to the month preceding the survey). Respondents working in agriculture have lower odds of seeking care than respondents with no employment.

Reported symptoms were similar in the two periods (table 43), with fever being the most commonly reported symptom (59% during COVID-19 restrictions and 56% in the last month before the survey), followed by cough (23% and 20%), chronic headaches (both 19%), severe diarrhea (15% and 19%) (table 43). Proportion of reported respiratory difficulties was similar in the two periods.

In terms of where people sought care, almost half and more than half of the respondents sought care at a hospital (48% during the COVID-19 restriction period and 66% during the month preceding the survey), followed by health clinic (25% and 43%) and pharmacy (16% vs 5%) (table 44). More respondents reported resorting to traditional healers during the COVID-19 restriction months (14%) than the month preceding the survey (7%). A higher proportion of respondents among i) the elderly group (vs younger); ii) female headed (vs male headed) households; non-displaced (vs displaced); resident in Bégoua (vs Bangui and

Bimbo) sought care at the hospital during both periods (except for the female-headed vs male-headed households who reported a more similar proportion during the month before the survey). Only 5% of the respondents in Bégoua reported seeking care at a health clinic during COVID-19 restrictions and 10% during the month before the survey.

The majority of the respondents (80%) reported vaccinating their children (table 45) during the first months of the COVID-19 restrictions. This was consistent across age groups, sex, residence, displacement status. In Bégoua, 62% of the respondents reported vaccinating children versus 78% in Bangui and 88% in Bimbo. Among the reasons mentioned for not vaccinating children, interruption of services was the most commonly provided (46%), particularly in Bégoua (70%). Fear of COVID-19 infection was the second reason (27%). A higher proportion of non-displaced (vs displaced) reported "services not provided" and "being worried about COVID-19 infections" as reasons for not vaccinating their children. Displaced respondents reported the suspension of vaccination campaigns more often than non-displaced respondents.

Qualitative results: Changes in health seeking behaviors

In more than half of the FGDs, respondents mentioned the fear of being diagnosed with COVID-19 when they went to the hospital. This is more a fear of the restrictions the diagnosis would have implied (quarantine for instance) than fear of the disease per se. It is reportedly one of the main reasons of diminishing frequency of medical consultations.

Health services continued to be provided, however fewer people are seeking care. Limited drug availability and lack of qualified personnel have also been reported in the three districts ("*ils ne disposent pas de véritable stock de medicament seulement les paracétamol et les quartem*" – women Bégoua FG1). Women in Bégoua and Bimbo also reported financial barriers to health.

Relevant Quotes

"*Nous avons peur de COVID-19 ce qui fait que nous respectons à la lettre les mesures barrières. Même si nous entendons qu'une personne n'est que suspectée d'être contaminée de COVID-19, nous ne l'approchons même pas; En écoutant même le nom de la maladie ça donne la peur*".

EN: "We are afraid of COVID-19 which makes us respect preventative measures to the letter. Even if we hear that a person is only suspected to be contaminated with COVID-19, we don't even go near them. Even hearing the name of the illness scares us."

FGD women 30 - 59, Bégoua

Table 41: Occurrence of illnesses and care seeking during the first months of the COVID-19 pandemic and 30 days prior to the survey, CAR, 2020-2021

	During the first months of the COVID-19 pandemic		During the 30 days preceding the survey							
					Barriers for not seeking care					
	% of HH reporting at least one HH member being sick	% of HH who sought care	% of HH reporting at least one HH member being sick	% of HH who sought care	Financial reasons (too expensive)	Illness not severe enough	HF too far away	Do not trust health care providers	Did not know how to access care	Security reasons (too dangerous)
Overall	24%	61%	42%	72%	87%	28%	22%	14%	7%	2%
Age of HoH										
18-29	23%	57%	36%	70%	86%	34%	28%	20%	1%	0%
30-59	24%	61%	42%	70%	89%	26%	19%	13%	10%	3%
60 +	26%	72%	55%	85%	76%	28%	28%	4%	0%	4%
Gender of HoH										
Female	25%	62%	47%	72%	94%	23%	23%	18%	9%	3%
Male	22%	61%	35%	72%	71%	41%	21%	7%	2%	1%
Displacement Status										
Non-displaced	24%	61%	42%	72%	87%	28%	22%	14%	7%	2%
Displaced	19%	31%	41%	60%	93%	24%	7%	0%	0%	0%
Health District										
Bangui	24%	58%	44%	78%	79%	41%	9%	12%	3%	0%
Bégoua	12%	90%	24%	79%	75%	38%	38%	0%	25%	0%
Bimbo	25%	67%	40%	56%	98%	10%	40%	18%	11%	5%
Setting										
Rural	14%	73%	29%	64%	86%	17%	48%	12%	21%	7%
Urban	25%	61%	43%	73%	87%	29%	20%	15%	5%	2%

Note: HoH: Head of Household

Table 42: Factors associated with seeking care during the month before the survey vs during the first months of COVID-19 restrictions, CAR

	Seeking care during first months of COVID-19 pandemic (N=204)			Seeking care during the 30 days preceding the survey (N=394)		
	Odds ratio	**Confidence interval**	**pvalue**	**Odds ratio**	**Confidence interval**	**pvalue**
Age (ref 18-29)						
30-59	2.202145	.720058 - 6.734793	0.163	1.162821	.6356066 - 2.127343	0.620
60 +	5.657212	.4828803 - 66.27739	0.164	4.366886	.8837768 - 21.5775	0.070
Displacement Status (ref residents)						
Displaced	.6557956	.1664672 - 2.5835	0.540	.9147162	.4041976 - 2.070041	0.829
Sex (ref male)						
Female	1.618599	.5867976 - 4.464676	0.346	**2.526121**	1.004675 - 6.351596	0.049
Religion (ref animist)				Empty		
Christian	.5105945	.0636536 - 4.095712	0.520	.3025765	.0512554 - 1.786201	0.184
Muslim	4.481124	.2975842 - 67.47827	0.273	omitted	-	-
Education (ref none)						
Primary	2.438964	.3103885 - 19.16484	0.390	1.288688	.4846115 - 3.426904	0.607
Secondary	**9.31578**	1.051576 - 82.52734	0.045	**4.317774**	2.204907 - 8.45531	0.000
University	1.20015	.0403023 - 35.73893	0.915	5.424787	.398224 - 73.89888	0.201
Setting (ref urban)						
Rural	.9254409	.3761906 - 2.276615	0.864	1.579569	.7170472 - 3.479601	0.253
Profession (ref none)						
Trade	.4950351	.2346631 - 1.044305	0.064	.5212307	.2617145 - 1.038083	0.063
Agriculture	.2766697	.0616052 - 1.242526	0.092	**.2260162**	.092632 - .5514656	0.001
Public official/ employee	1.153951	.1469502 - 9.061588	0.890	1.369648	.1177563 - 15.93066	0.799
Other	.5995615	.0672222 - 5.34755	0.641	.7972431	.0468999 - 13.55219	0.874
Health District (ref Bangui)						
Bégoua	**41.35403**	3.431711 - 498.3392	0.004	4.576156	.9093531 - 23.02868	0.065
Bimbo	**3.975314**	1.053123 - 15.00597	0.042	.864283	.2706733 - 2.759729	0.803
Knowledge of COVID-19 (ref not informed)						
Partially Informed	.6045692	.1548969 - 2.359659	0.462	.3400998	.1055381 - 1.095982	0.070
Informed	1.295162	.4295941 - 3.90472	0.640	.9876711	.2635364 - 3.701555	0.985
Well Informed	-	-	-	2.629322	.1304352 - 53.00204	0.524

Table 43: What were the symptoms of the sick person?

	During the first months of COVID-19 pandemic						In the 30 days before the survey					
	Fever	Cough	Severe Diarrhea	Chronic Headaches	Respiratory Difficulties	Other	Fever	Cough	Severe Diarrhea	Chronic Headaches	Respiratory Difficulties	Other
Overall	59%	23%	19%	19%	7%	30%	56%	20%	15%	19%	8%	43%
Age of HoH												
18-29	53%	31%	24%	20%	3%	24%	67%	22%	22%	21%	8%	31%
30-59	62%	19%	16%	19%	7%	31%	60%	20%	13%	20%	7%	44%
60 +	61%	26%	21%	13%	13%	33%	26%	15%	12%	16%	9%	58%
Gender of HoH												
Female	56%	25%	19%	17%	4%	33%	54%	19%	13%	21%	9%	46%
Male	65%	18%	18%	22%	12%	23%	61%	21%	18%	16%	5%	35%
Displacement Status												
Non-displaced	59%	23%	19%	19%	7%	30%	56%	20%	15%	19%	8%	43%
Displaced	78%	42%	28%	17%	3%	17%	68%	29%	15%	23%	8%	24%
Health District												
Bangui	54%	25%	17%	19%	8%	34%	60%	21%	16%	20%	6%	42%
Bégoua	70%	10%	5%	15%	0%	59%	74%	3%	5%	13%	0%	47%
Bimbo	73%	18%	25%	17%	3%	17%	44%	16%	13%	18%	11%	47%
Setting												
Rural	80%	24%	27%	7%	0%	33%	60%	14%	18%	12%	3%	38%
Urban	58%	23%	18%	19%	7%	30%	56%	20%	14%	20%	8%	43%

Note: HoH: Head of Household

Table 44: Where did people seek care during covid-19 vs in the 30 days before the survey

	During the first months of the COVID-19 pandemic						The 30 days before the survey					
	Hospital	Health Clinic	Pharmacy	Traditional Healer	Private Doctor	Other	Hospital	Health Clinic	Pharmacy	Traditional Healer	Private Doctor	Other
Overall	48%	25%	16%	14%	2%	17%	66%	43%	5%	7%	3%	1%
Age of HoH												
18-29	45%	27%	14%	14%	3%	17%	65%	48%	7%	7%	0%	3%
30-59	45%	26%	17%	16%	3%	19%	62%	47%	4%	7%	4%	1%
60 +	66%	13%	13%	0%	0%	8%	82%	25%	4%	4%	0%	0%
Gender of HoH												
Female	55%	19%	17%	12%	4%	16%	65%	45%	5%	6%	2%	1%
Male	33%	35%	15%	17%	0%	19%	68%	39%	5%	7%	4%	1%
Displacement Status												
Non-displaced	48%	25%	16%	14%	2%	17%	66%	43%	5%	7%	3%	1%
Displaced	25%	39%	0%	11%	0%	25%	49%	40%	2%	6%	0%	6%
Health District												
Bangui	50%	25%	8%	17%	4%	21%	68%	41%	3%	7%	3%	1%
Bégoua	75%	5%	0%	20%	0%	0%	70%	10%	17%	10%	0%	10%
Bimbo	40%	25%	35%	6%	0%	7%	57%	54%	9%	6%	1%	0%
Setting												
Rural	44%	31%	22%	9%	0%	9%	49%	27%	17%	15%	3%	5%
Urban	48%	24%	16%	14%	3%	17%	67%	44%	4%	6%	3%	1%

Note: HoH: Head of Household

Table 45: Did you vaccinate your children during the first months of restrictions during COVID-19?

	Did you have your children vaccinated during the first months of restrictions against COVID-19?			If not, why?					
	Yes	No	Prefer not to respond	Vaccination services not offered	Household was worried about COVID-19 infections	Certain vaccination campaigns were interrupted	Household had other commitments	Other	Prefer not to respond
Overall	80%	19%	1%	46%	27%	6%	3%	28%	4%
Age of HoH									
18-29	80%	19%	1%	42%	41%	7%	0%	20%	0%
30-59	81%	18%	1%	47%	24%	6%	6%	28%	3%
60 +	77%	23%	1%	47%	15%	1%	0%	30%	14%
Gender of HoH									
Female	82%	17%	1%	43%	26%	6%	4%	27%	4%
Male	77%	23%	1%	49%	28%	6%	3%	25%	3%
Displacement Status									
Non-displaced	80%	19%	1%	46%	27%	6%	3%	26%	4%
Displaced	87%	9%	4%	12%	12%	18%	0%	59%	6%
Health District									
Bangui	78%	21%	1%	47%	24%	3%	4%	30%	3%
Bégoua	62%	37%	1%	70%	15%	30%	2%	7%	5%
Bimbo	88%	11%	0%	27%	46%	10%	1%	17%	8%
Setting									
Rural	76%	22%	2%	52%	24%	27%	2%	12%	6%
Urban	81%	19%	1%	45%	28%	3%	3%	28%	3%

Note: HoH: Head of Household

4.4.8 Social interactions

Quantitative results

Questions about social interactions included two main areas: 1) changes in type, frequency, duration and location of interactions during the months with COVID-19 restrictions; and, 2) characteristics of social interactions the day before the survey.

During the months when COVID-19 related restrictions were in place (table 46), a bit more than half of the respondents (55%) reported meeting less often than before; 29% reported stopping all meetings outside the household (50% in Bégoua); 9% reported no change (37% in Bégoua). Most of the respondents (78%) also reported that meetings were shorter (44% in Bégoua). 12% of the respondents reported no change in the length of their meetings and another 10% reported that meetings were longer. There was little variation across age groups, sex of the head of the household, residence or setting. Only Begoua showed results that were more distant than average.

When asked about the previous day's interactions, on average, respondents reported interacting with 4 people (table 47), with little variation across age or gender of the head of the household, displacement status, regions, and setting. Interactions were mainly with young adults (average age 31 years), equally between men and women (although female headed households tend to interact more with women and men-headed household with men). Most of the interactions were with other family members (43%) or other relatives (29%) and friends (18%). Almost all interactions (92%) included physical touch such as hand shaking or hug. The contacts were mainly students/pupils or laborers (table 47).

Most of the interactions occurred either at the home of the respondents (42%) or in another house (23%) (table 48). A higher proportion of older people met at home. Meeting in another person's house seems less common in Bégoua (8%). Interactions at the market, work or in a worship place represented between 5% and 7% of the encounters. The majority of the interactions (66%) were conducted outdoor; however, we can note important differences among districts: 74% in Bangui, 93% in Bégoua and 42% in Bimbo.

In terms of duration, almost half of the interactions (46%) lasted between 15 minutes and 1 hour; and 29% between 1 and 4 hours. This was consistent across groups.

As far as protective measures are concerned, in 95% of the interactions none of the participants wore a mask and in 3% of the cases, both participants wore it. This is different in Bégoua where 18% of the respondents reported wearing a mask. Discordant wearing of mask (i.e., either the respondent or the contact) is rare (1%).

Respondents said that 77% of the interactions could have also been conducted remotely. This was less so among displaced (62%) and in rural setting (64%). Several reasons were provided for not being able to conduct the interactions remotely: preference to meet in person (35%), lack of telephone credit (31%), no access to telephone (28%).

Most of the interactions occurred with known contacts: 49% of the contacts were met at least once a week in the previous 30 days, 33% daily, and 15% at least once. First time contacts represented 2% of total interactions.

Qualitative results

The COVID-19 pandemic had a strong impact on the frequency of social interactions and some participants suggested it was still the case today. Family bounds were preserved, even if "separation" was sometimes reported. Most participants reported reducing meeting with family members, friends and other people. Perception on the continuation or interruption of “leisure activities” such as going to bar or restaurant varied. Some respondents from Bangui reported a reduced attendance to restaurants and cafés, others also from Bangui reported some venues remained open and people continued meeting but “secretly”. Also, the perceived respect of preventative barriers varied, with some reporting compliance and others rather questioning their application. Despite restrictions, people kept meeting face to face mainly for work and shopping. Events like wedding still took place but “they were not at before” due to the limitations on the number of guests. School attendance was strongly impacted, as almost all schools were closed during several months. Those with financial resources were able to pay for tutors for children but this resource was not available to all. In few instances, classes were broadcasted via radio and USB sticks were distributed. However, complaints about the implementation of this activity were reported.

Meeting restrictions importantly impacted religious institutions where all activities had to stop: “*Tout s'était arrèté, aucune reunion, aucun regroupement et ça a joué énormement sur l'église, l'école et jusqu'à aujourd'hui tout le monde en paye le prix, la vie n'avait aucun sens on se sentait comme en prison*” (everything had stopped, no meeting, no regrouping and it had a huge impact on the church the school and until today everyone is paying the price, life had no meaning, we feel like in prison” (FG4).

Those in Bangui reported praying at home. Masses were still allowed but at decreased capacity. Prayers were also broadcasted via radio.

Participants reported general awareness of the elderly as being particularly vulnerable to COVID-19, and therefore a diminution of interactions with this age group. Participants from this age group though lamented feeling discriminated because of their age, saying that people fear them, and that young people avoided meeting with them as they are more vulnerable (“*les jeunes ne veulent plus s’approcher de nous en pensant que nous sommes les plus vulnérables*” (the young people no longer want to approach us thinking that we are the most vulnerable) (FG19)). Participants from another FGD went as far to say that some have contempt for elderly (“*certains groupes de population ont du mépris vis à vis des personnes agées; ils sont mises à l'écart*” FG1).

Limited alternatives to avoid meetings were mentioned. Telephone calls could at time replace meetings, but respondents reported difficulties to find alternative for working, or going to the market.

Respondents reported that people were worried to meet during the first months; this has decreased over time. At the time of data collection, people seem less worried, mainly because they think the risk has decreased (COVID perceived as gone, Fewer (reported) cases, and the vaccine has arrived.

A focus group of men aged 31-59 said that there is a fear of those who come from abroad contaminating them with COVID-19. All focus groups held in Bimbo said that the number of people in the household has increased since COVID-19.

Relevant Quotes:

"On avait entendu que la maladie de COVID-19 n'atteignent que les personnes âgées ce qui fait les gens ont peur de les approchés, surtout lorsque c'est personnes âgées toussent beaucoup les gens les fuient encore plus."

EN: "We had heard that COVID-19 only affects the elderly which made people afraid of going near them, especially when these elderly people cough a lot people avoid them even more."

FGD women 31 - 59, Bimbo

"Les gens se rencontrent en secret malgré les restrictions pour des diverses raison de travail, pour des ventes et achat dans les boutiques, pour rencontrer les responsables religieux, les gens se mettent en cachette dans les lieux de vente de bière et alcool pour les boire, les gens se rencontrent en secret pour des diverses réunions."

EN: "People meet in secret despite the restrictions for various reasons relating to work, to buy and sell things in shops, to meet religious leaders, people hide in places where alcohol and beer are sold to drink, people see each other in secret for various meetings."

FGD men 31 - 59, Bégoua

"*Tout s'était arrèté, aucune reunion, aucun regroupement et ça a joué énormement sur l'église, l'école et jusqu'à aujourd'hui tout le monde en paye le prix, la vie n'avait aucun sens on se sentait comme en prison*"

EN: "Everything had stopped, no meeting, no gathering and it had a huge impact on the church, the school and until today everyone is paying the price, life had no meaning, we felt like in prison"

FGD men 31 - 59, Bégoua

"*Les jeunes ne veulent plus s'approcher de nous en pensant que nous sommes les plus vulnérables*"

EN: "The young people no longer want to approach us thinking that we are the most vulnerable"

FGD, mixed, 60+, Bangui, IDP

"Les gens s'inquiètes beaucoup plus de se rencontrer avec les personnes qui viennent de Bangui car selon eux la maladie est beaucoup plus développée à Bangui. Mais entre la population de Bogangolo, il n'ya pas d'inquiètude de rencontrer entre eux"

EN: "People are much more worried about meeting people who come from Bangui because according to them the disease is much more developed in Bangui. But between the population of Bogangolo, there is no concern to meet between them"

FGD men 31 - 59, Bégoua

“On s'inquietait plus au premier stade de la pandemie mais maintenant nous avons moins en moins d'inquiétude parce que on croit que le COVID est entrain de partir”

EN: “We were more worried at the first stage of the pandemic but now we are less and less worried because we believe that the COVID is leaving”

FGD men 18 - 30, Bimbo, IDP

« Oui les parents avec de moyens prennent les précepteure pour enseigner leurs enfants à la maison, ils frequent toujours le marché mais en mattant les masques, au lieu de travail le nombre est limité et pour l'église rien que les leader qui se retrouve”

EN: “Yes parents with [financial] means take the tutor to teach their children at home, they still visit the market but by putting on the masks, at the workplace the number is limited and for the church only the leaders meet”

FGD women 31 - 59, Bangui, IDP

“Y'avait une alternative pour l'école à travers la distribution des postes radios plus clé USB avec un cours audio permattant au élèves de suivi le cours par la radio sr place à la place à la maison. Malheuresement y'avait une mavaise gestion de cette distribution”

EN: “There was an alternative for the school through the distribution of radios plus USB keys with an audio course allowing students to follow the course by radio instead of at home. Unfortunately there was a mismanagement of this distribution”

FGD men 31 - 59, Bangui, IDP

Table 46: Changes in social interactions during the months following the introduction of COVID-19 restrictions in CAR

	Overall	Age of HoH			Gender of HoH		Displacement status		Health district			Setting	
		18-29	30-59	60+	F	M	Non-IDP	IDP	Bangui	Bégoua	Bimbo	Rur	Urb
% of persons who report a change in the frequency of meetings/social interaction compared to before restrictions were put in place													
During the months when the restrictions were in place (end of March 2020 -end of May 2020), how did the frequency of your meetings / social interactions change, compared to before the restrictions were in place?													
I met people less often	55%	60%	52%	53%	55%	54%	55%	58%	54%	11%	63%	47%	55%
I stopped meeting people (except for my family)	29%	27%	30%	29%	30%	27%	29%	13%	33%	50%	15%	26%	29%
No change	9%	7%	9%	8%	7%	11%	9%	14%	6%	37%	10%	21%	7%
I met people more often	4%	4%	4%	5%	4%	4%	4%	5%	5%	1%	3%	2%	5%
I stopped meeting people (including my family)	3%	2%	4%	3%	3%	4%	3%	11%	2%	2%	7%	4%	3%
Do not know / prefer not to respond	0%	----	0%	2%	1%	----	0%	----	----	----	1%	0%	0%
% of persons who report a change in the length of meetings/social interaction compared to before restrictions were put in place													
During the months when the restrictions were in place (end of March 2020-end of May 2020), how did the length of your meetings / social interactions change, compared to before the restrictions were in place?													
Meetings are shorter	78%	76%	78%	82%	81%	73%	78%	78%	84%	44%	67%	59%	80%
No change	12%	12%	12%	8%	9%	17%	12%	18%	11%	40%	11%	24%	11%
Meetings are longer	10%	11%	9%	9%	9%	10%	10%	1%	5%	16%	21%	16%	9%
Prefer not to respond	1%	1%	1%	0%	1%	1%	1%	2%	1%	----	2%	1%	1%

Note: IDP= Internally displaced people; HoH: Head of Household

Table 47: Characteristics of the contacts during interactions occurred the day before the survey, CAR

	Overall	Age of HoH			Gender of HoH		Displacement status		Health district			Settlement type	
		18-29	30-59	60 +	F	M	Non-IDP	IDP	Bangui	Bégoua	Bimbo	Rur	Urb
Average number of individuals with whom the respondent interacted yesterday	4	4	4	3	4	4	4	4	4	3	3	3	4
Average age of persons that the respondent was in contact with	31	26	32	37	30	32	31	30	31	35	32	33	31
% of interactions of respondent per gender of contact													
Woman	53%	56%	50%	55%	62%	38%	53%	48%	52%	44%	55%	50%	53%

	Overall	Age of HoH			Gender of HoH		Displacement status		Health district			Settlement type	
		18-29	30-59	60 +	F	M	Non-IDP	IDP	Bangui	Bégoua	Bimbo	Rur	Urb
Man	47%	44%	50%	45%	38%	62%	47%	52%	48%	56%	45%	50%	47%
% of interactions with reported physical contact such as a handshake or a hug													
Yes	92%	93%	91%	90%	91%	92%	92%	89%	92%	93%	91%	92%	92%
No	8%	7%	9%	10%	9%	8%	8%	11%	8%	7%	9%	8%	8%
% of interactions per type of relationship with contact													
Household member	43%	45%	40%	48%	47%	35%	43%	39%	42%	31%	45%	45%	42%
Other relative	29%	27%	30%	31%	30%	28%	29%	30%	29%	34%	30%	29%	29%
Friend	18%	20%	18%	11%	13%	25%	17%	21%	17%	26%	17%	18%	17%
Other	4%	1%	5%	6%	5%	3%	4%	3%	5%	2%	2%	2%	4%
Professional contact	3%	2%	4%	2%	2%	5%	3%	2%	3%	3%	3%	3%	3%
Colleague	3%	3%	3%	0%	2%	4%	3%	4%	3%	2%	2%	2%	3%
Classmate	0%	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	0%
Do not know / prefer not to respond	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	1%	0%	0%
% of interactions by role of contact													
Student / pupil	21%	26%	19%	18%	22%	19%	21%	14%	25%	5%	11%	7%	22%
Other	18%	19%	18%	18%	19%	18%	18%	16%	19%	9%	19%	9%	19%
Producer (agriculture, livestock etc)	12%	10%	13%	12%	12%	12%	12%	15%	4%	67%	25%	52%	8%
Day laborer / temporary worker	11%	9%	12%	8%	9%	13%	11%	18%	13%	7%	5%	5%	11%
Unemployed	10%	12%	10%	8%	12%	8%	10%	9%	11%	0%	10%	3%	11%
Child	9%	9%	9%	10%	10%	8%	9%	10%	8%	6%	12%	11%	9%
Wife or husband	6%	5%	6%	10%	6%	7%	6%	8%	6%	3%	7%	6%	6%
Public official	4%	5%	4%	5%	4%	5%	4%	2%	5%	1%	3%	1%	5%
Employee (outside government)	3%	2%	4%	2%	3%	4%	3%	3%	3%	0%	4%	1%	4%
Community / religious leader	2%	1%	3%	2%	2%	3%	2%	4%	2%	1%	2%	3%	2%
Health worker	2%	1%	2%	3%	1%	3%	2%	1%	2%	1%	2%	1%	2%
Teacher	2%	1%	2%	3%	2%	1%	2%	0%	2%	1%	0%	0%	2%
% of interactions by role of contact, among persons who report having had physical contact during an interaction													
Student / pupil	21%	27%	19%	20%	22%	19%	21%	14%	26%	5%	12%	7%	22%
Other	18%	18%	18%	18%	18%	17%	18%	15%	18%	9%	19%	9%	19%
Producer (agriculture, livestock etc)	12%	11%	12%	12%	12%	11%	12%	16%	4%	65%	25%	52%	8%

	Overall	Age of HoH			Gender of HoH		Displacement status		Health district			Settlement type	
		18-29	30-59	60 +	F	M	Non-IDP	IDP	Bangui	Bégoua	Bimbo	Rur	Urb
Unemployed	10%	12%	10%	9%	12%	8%	10%	10%	11%	0%	10%	4%	11%
Day laborer / temporary worker	10%	9%	12%	8%	9%	13%	10%	19%	13%	8%	4%	5%	11%
Child	9%	10%	9%	10%	10%	8%	9%	10%	8%	6%	12%	11%	9%
Wife or husband	6%	5%	6%	9%	6%	8%	6%	8%	7%	3%	6%	6%	6%
Public official	4%	5%	4%	4%	3%	6%	4%	1%	5%	1%	4%	1%	5%
Employee (outside government)	3%	2%	4%	2%	3%	4%	3%	2%	3%	0%	3%	1%	3%
Community / religious leader	2%	1%	3%	1%	2%	3%	2%	4%	2%	2%	2%	3%	2%
Health worker	2%	1%	1%	4%	1%	2%	2%	1%	2%	1%	2%	1%	2%
Teacher	1%	1%	2%	2%	1%	1%	1%	0%	2%	1%	0%	0%	1%

Note: IDP= Internally displaced people; HoH: Head of Household

Table 48: Characteristics of the interactions (location, duration, protective measures) occurred the day before of the survey, CAR

	Overall	Age of HoH			Gender of HoH		Displacement status		Health district			Settlement type	
		18-29	30-59	60 +	F	M	Non-IDP	IDP	Bangui	Bégoua	Bimbo	Rural	Urban
% of interactions by place of encounter													
My home	42%	39%	42%	55%	45%	38%	42%	36%	41%	64%	43%	50%	42%
Another home	23%	26%	21%	24%	23%	22%	23%	29%	22%	8%	26%	20%	23%
While walking	7%	8%	7%	5%	7%	8%	7%	10%	6%	8%	11%	12%	7%
Shop / market	7%	9%	7%	2%	9%	5%	7%	8%	9%	2%	4%	3%	8%
At work	6%	2%	8%	2%	2%	13%	6%	4%	7%	1%	4%	2%	6%
Place of worship	5%	5%	5%	4%	5%	4%	5%	5%	5%	10%	4%	6%	5%
Leisure area	4%	4%	4%	1%	2%	6%	4%	3%	3%	1%	4%	3%	4%
Other	3%	3%	3%	3%	3%	3%	3%	1%	3%	3%	3%	2%	3%
Community building (for example health center)	1%	1%	1%	2%	1%	1%	1%	3%	1%	0%	1%	0%	1%
School	1%	2%	0%	1%	1%	0%	1%	0%	1%	1%	0%	1%	1%
Restaurant/café	0%	1%	1%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Private transport (car, taxi)	0%	0%	1%	0%	1%	0%	0%	0%	1%	0%	0%	0%	0%
Public transport (for example bus)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

	Overall	Age of HoH			Gender of HoH		Displacement status		Health district			Settlement type	
		18-29	30-59	60 +	F	M	Non-IDP	IDP	Bangui	Bégoua	Bimbo	Rural	Urban
Do not know / prefer not to respond	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
% of interactions indoor / outdoor													
Outdoor	66%	65%	66%	67%	65%	68%	66%	62%	74%	93%	42%	63%	66%
Indoor	34%	35%	34%	33%	35%	32%	34%	38%	26%	7%	58%	37%	34%
% of interactions by duration of encounter													
15 mins to 1 hour	46%	47%	44%	49%	44%	47%	46%	42%	50%	38%	36%	37%	46%
1 to 4 hours	29%	26%	30%	24%	27%	32%	29%	26%	33%	27%	18%	22%	29%
Less than 15 mins	18%	17%	18%	22%	22%	13%	18%	27%	14%	11%	31%	28%	17%
More than 4 hours	7%	9%	7%	4%	7%	8%	7%	4%	4%	25%	14%	13%	7%
Do not know / prefer not to respond	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
% of interactions by mask use													
No - neither of us	95%	98%	94%	98%	95%	95%	95%	98%	95%	81%	98%	97%	95%
Yes - both of us	3%	1%	5%	0%	3%	3%	3%	1%	3%	18%	2%	3%	3%
Yes - only the contact	1%	1%	1%	2%	0%	2%	1%	0%	1%	0%	1%	0%	1%
Yes - only me	1%	0%	1%	0%	1%	0%	1%	0%	1%	1%	0%	0%	1%
Do not know / prefer not to respond	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
% of interactions by mask use and age category of contact person													
No - neither of us /30-59 years	51%	32%	57%	62%	46%	60%	51%	63%	52%	48%	49%	54%	51%
No - neither of us /18-29 years	44%	66%	37%	37%	50%	36%	44%	35%	44%	34%	48%	43%	45%
Yes - both of us / 30-59 years	2%	0%	4%	0%	3%	2%	2%	0%	2%	17%	1%	2%	2%
Yes - only the contact /30-59 years	1%	1%	0%	1%	0%	1%	1%	0%	1%	0%	0%	0%	1%
Yes - both of us / 18-29 years	1%	0%	1%	0%	0%	1%	1%	1%	0%	1%	1%	0%	1%
Yes - only me /18-29 years	0%	0%	1%	0%	1%	0%	1%	0%	1%	0%	0%	0%	1%
Yes - only the contact /18-29 years	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%
Yes - only me /30-59 years	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%
% of interactions by duration of encounter and mask use													
No - neither of us /15 mins to 1 hour	43%	47%	41%	47%	42%	45%	43%	41%	47%	26%	35%	36%	44%
No - neither of us / 1 to 4 hours	27%	26%	29%	23%	25%	30%	27%	26%	31%	22%	18%	21%	28%
No - neither of us / Less than 15 mins	18%	16%	17%	22%	21%	13%	18%	27%	13%	10%	31%	27%	17%

	Overall	Age of HoH			Gender of HoH		Displacement status		Health district			Settlement type	
		18-29	30-59	60 +	F	M	Non-IDP	IDP	Bangui	Bégoua	Bimbo	Rural	Urban
No - neither of us / More than 4 hours	7%	9%	6%	4%	7%	7%	7%	4%	3%	23%	13%	13%	6%
Yes - both of us / 15 mins to 1 hour	2%	0%	2%	0%	2%	2%	2%	1%	1%	11%	1%	1%	2%
Yes - both of us / 1 to 4 hours	1%	0%	2%	0%	1%	1%	1%	0%	1%	5%	0%	1%	1%
Yes - only the contact /15 mins to 1 hour	0%	1%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%
Yes - both of us / More than 4 hours	0%	0%	1%	0%	0%	0%	0%	0%	0%	1%	1%	1%	0%
Yes - only me /15 mins to 1 hour	0%	0%	1%	0%	1%	0%	0%	0%	1%	0%	0%	0%	0%
Yes - only the contact / Less than 15 mins	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%
Yes - only me /Less than 15 mins	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Yes - only the contact /1 to 4 hours	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Yes - both of us /Less than 15 mins	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	1%	0%
Yes - only me /1 to 4 hours	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Do not know / prefer not to respond	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Yes - only me /More than 4 hours	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
% of interactions by mask use and place													
No - neither of us /Outdoor	75%	83%	72%	76%	76%	74%	75%	79%	79%	80%	63%	79%	75%
No - neither of us /Indoor	20%	15%	22%	22%	19%	21%	20%	20%	15%	1%	35%	18%	20%
Yes - both of us / Indoor	3%	1%	5%	0%	3%	3%	3%	1%	3%	18%	2%	3%	3%
Yes - only the contact /Indoor	1%	1%	1%	2%	0%	2%	1%	0%	1%	0%	1%	0%	1%
Yes - only me /Indoor	1%	0%	1%	0%	1%	0%	1%	0%	1%	1%	0%	0%	1%
% of interactions that could have also been conducted remotely													
Yes	77%	77%	79%	70%	76%	80%	77%	62%	75%	72%	83%	64%	79%
No	23%	23%	21%	30%	24%	20%	23%	38%	25%	28%	17%	36%	21%
Reason given for not being able to conduct the interaction remotely													
We prefer to meet in person	35%	26%	42%	22%	30%	45%	35%	32%	38%	15%	25%	22%	37%
No telephone credit	31%	39%	29%	22%	32%	29%	31%	10%	35%	7%	18%	10%	33%
No telephone access	28%	28%	27%	35%	30%	24%	28%	42%	25%	79%	35%	53%	25%
It required a physical contact	28%	22%	31%	26%	23%	36%	28%	38%	26%	14%	38%	33%	27%
The subject of the meeting was sensitive	6%	4%	8%	0%	5%	9%	6%	7%	6%	4%	5%	9%	6%
Other	5%	7%	5%	1%	7%	2%	5%	3%	6%	6%	2%	2%	5%

	Overall	Age of HoH			Gender of HoH		Displacement status		Health district			Settlement type	
		18-29	30-59	60 +	F	M	Non-IDP	IDP	Bangui	Bégoua	Bimbo	Rural	Urban
No internet access	1%	1%	1%	4%	1%	1%	1%	3%	1%	5%	1%	2%	1%
Do not know / prefer not to respond	1%	1%	1%	1%	1%	1%	1%	2%	1%	0%	2%	1%	1%
Not trusting telephone / internet for making calls	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%
Average frequency of meetings with contact during the last 30 days													
At least once a week (in the last 30 days)	49%	53%	48%	43%	46%	54%	49%	38%	53%	45%	41%	46%	49%
Every day (in the last 30 days)	33%	29%	35%	34%	33%	33%	33%	45%	27%	46%	46%	43%	32%
At least once (in the last 30 days)	15%	15%	14%	21%	17%	12%	15%	13%	16%	9%	12%	10%	16%
Never met this person before	2%	1%	2%	2%	3%	1%	2%	2%	2%	0%	1%	1%	2%
Do not know / prefer not to respond	1%	1%	1%	0%	1%	0%	1%	1%	1%	0%	0%	0%	1%

Note: IDP= Internally displaced people; HoH: Head of Household

4.4.9 Access to WASH

Quantitative results

Half of the respondents reported having a hand washing facility (HWF) at home with improved water source and soap. An additional 11% has access to a HWF in the community (table 49). Financial barriers (cost of both water and soap) are the most reported reasons why people do not have access to a HWF (80% and 22% respectively). Cost of water seems to be a bigger problem in urban (84%) than in rural areas (37%). Distance to water source was mentioned by 9% of the respondents, however this proportion raised to 14% and 18% in Bégoua and Bimbo respectively. Similarly, water quality was indicated as a barrier by 2% of the total respondents; however, this proportion raises to 11% in Bégoua and 12% in Bimbo.

Access and insecurity were mentioned by 1% of the respondents.

The majority of the HWF were not available before COVID-19.

Most of the respondents think that people are using HWF more than before COVID-19, and on a regular basis to avoid the risk of spreading COVID-19.

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

Respondents reported increased access to hand washing facilities compared to before the pandemic. However, it is still not sufficient for the entire community. Some HWS have also been installed in public spaces such as in front of churches. National and international NGOs have installed HWF since the beginning of the pandemic, but utilization has decreased for a variety of reasons. Some participants mentioned the belief that there are no more cases (and therefore there is no need to use HWF). Others reported that some HWF are no longer functional, and access to water and soap is difficult and costly. Additional barriers include insufficient boreholes, long waiting time and long distance to both water points and HWF.

Relevant Quotes:

"Il y'a beaucoup des dispositifs de lavage de main (DLM), au marché, chez le chef du quartier, à l'école, à l'église, à l'hôpital, même chez chaque ménage il y'a les théières que les gens utilisent aussi pour le lavage des mains. Les ONG telles que ACTED, Croix-Rouge, PAM ont aidé pour l'installation de ces dispositifs dans les lieux publics."

EN: "There are lots of hand washing facilities, at the market, at the local chief's house, at schools, at churches, at hospitals, even at each household there are teapots that people also use for hand-washing. NGOs like ACTED, the Red Cross, WFP helped to install these hand washing facilities in public places."

FGD women 18 - 31, Bimbo

Table 49: Access to WASH services among respondents to the household survey, CAR

	Overall	Age of HoH			Gender of HoH		Displacement status		Health district			Setting	
	Overall	18-29	30-59	60 +	F	M	Non-IDP	IDP	Bangui	Bégoua	Bimbo	Rural	Urban
% of HH with access to functional hand washing facility (HWF) (improved water source and soap)?													
Yes, at home	53%	51%	52%	59%	51%	56%	53%	33%	49%	25%	66%	47%	53%
No	36%	39%	38%	24%	36%	36%	36%	56%	43%	50%	19%	39%	36%
Yes, in the community	11%	10%	10%	18%	12%	8%	11%	10%	8%	25%	15%	14%	11%
Do not know / prefer not to respond	0%	0%	0%	0%	0%	----	0%	1%	----	----	0%	1%	0%
Was this already available before COVID-19 (March 2020)?													
No	63%	88%	57%	43%	63%	62%	63%	----	63%	----	----	----	63%
Yes	37%	13%	43%	57%	37%	38%	37%	----	37%	----	----	----	37%
% of HH who, compared to before March 2020, report using the HWF…													
More often	68%	100%	68%	50%	71%	64%	68%	----	68%	----	----	----	68%
Less often	24%	----	26%	25%	14%	36%	24%	----	24%	----	----	----	24%
As often as before	8%	----	5%	25%	14%	----	8%	----	8%	----	----	----	8%
% of HWF installed in the community during COVID to sensitize the population to hand-washing to reduce the risk of spreading the virus?													
Yes	71%	71%	76%	33%	67%	78%	71%	----	71%	----	----	----	71%
No	26%	21%	24%	67%	29%	22%	26%	----	26%	----	----	----	26%
Do not know / prefer not to respond	2%	7%	----	----	4%	----	2%	----	2%	----	----	----	2%
% of HH who think that the community regularly uses this HWF to avoid the risk of spreading COVID-19?													
Yes	70%	60%	79%	----	69%	71%	70%	----	70%	----	----	----	70%
No	30%	40%	21%	100%	31%	29%	30%	----	30%	----	----	----	30%
What prevents you from having access to a functional HWF?													
Lack financial means / water is too expensive	80%	82%	80%	72%	76%	86%	80%	74%	92%	30%	30%	37%	84%

	Overall	Age of HoH			Gender of HoH		Displacement status		Health district			Setting	
	Overall	18-29	30-59	60 +	F	M	Non-IDP	IDP	Bangui	Bégoua	Bimbo	Rural	Urban
Soap is too expensive	22%	26%	20%	29%	23%	21%	22%	30%	20%	8%	38%	15%	23%
Other	12%	14%	11%	12%	15%	5%	12%	18%	9%	46%	15%	35%	9%
The distance to the water source is too long	9%	7%	10%	1%	9%	8%	9%	7%	7%	14%	18%	11%	8%
Soap is not available at the market	7%	4%	7%	14%	9%	3%	7%	4%	2%	4%	33%	7%	7%
The water source does not work / is closed	6%	8%	6%	0%	7%	5%	6%	5%	7%	6%	4%	4%	7%
The wait is too long / insufficient number of water sources	3%	3%	3%	1%	2%	4%	3%	8%	2%	6%	5%	5%	2%
The water is quality is not good (the water is brownish, smells foul or is saline)	2%	3%	2%	1%	4%	0%	2%	3%	0%	11%	12%	7%	2%
Do not know / prefer not to respond	2%	2%	1%	1%	1%	2%	2%	5%	1%	4%	2%	5%	1%
Certain groups (children, women, elderly, ethnic minorities) do not have access to water sources	1%	0%	2%	0%	2%	0%	1%	0%	1%	0%	4%	1%	1%
The road to, or the area of, the water access is too dangerous	1%	0%	1%	0%	1%	0%	1%	1%	0%	1%	4%	1%	1%
Access is difficult	1%	2%	0%	0%	0%	2%	1%	0%	1%	0%	0%	1%	1%
Water is not available at the market	0%	0%	0%	1%	0%	0%	0%	1%	0%	4%	0%	3%	0%

Note: IDP= Internally displaced people; HoH: Head of Household

4.4.10 Additional qualitative results

Specific issues with vulnerable populations

Feeling about being discriminated as vulnerable population is not strong. Interestingly, when asked about it, participants of other age category felt significantly more discriminated.

Men in Bégoua age 18 to 30 and 31 to 59 reported that they received information about the most vulnerable people being the most exposed to the virus. This group of men felt more at risk for the virus and took all precaution measures. Men in Bégoua of all ages reported that travelers are more at risk because they do not respect the barrier measures and are not vaccinated.

Women in Bimbo reported feeling more at risk compared to other individuals especially those who are constantly out walking (FG10). A group of men in Bimbo aged 18 to 30 claimed they received no information about who is more at risk for COVID-19. However, women in Bimbo aged 31 to 59 said that people who are more vulnerable include those who are 60+ because they are the ones dying the most from this pandemic. Men in Bimbo also said that those who do not respect barrier measures were more at risk for COVID-19. Men and women in Bimbo said that those in the 3rd age category and infants were the most at risk. People in Bimbo aged 60 and older also reported that they feel discriminated against because of their age.

Focus groups of women and displaced persons in Bangui reported that those in the 3rd age category are the most at risk for COVID-19. Another focus group of men aged 18 to 30 reported that those who become weak due to their ages, their defense system is reduced due to COVID-19 (FG22). All focus groups in Bangui reported adhering to COVID-19 prevention methods ones cited included: hand washing, nose masks, and avoiding physical contact and crowds.

Relevant Quotes:

"Nous avons les mêmes informations (à travers la radio, les hôpitaux…) et mêmes traitements de la situation COVID-19 que tout autres membres de la communauté. Il y'a des organisations qui nous sont venues en aide à travers les dons de savon, de théières, les caches nez…afin de se protéger contre la COVID-19. Mais malheureusement, les personnes en charge de distribution de ses dons privilégient que leurs parents proches au détriment des autres bénéficiaires."

EN: "We have the same information (from radios, from hospitals...) and same treatments of the COVID situation as all the other members of the community. There are organizations which have come to help us with soap, teapots, masks... to protect against COVID-19. But unfortunately, the people in charge of distributing these donations favor only their relatives, to the detriment of other beneficiaries."

FGD Vulnerable Mixed, Bimbo

5 Discussion

This study brings together complementary areas of research to generate a more comprehensive, albeit incomplete, understanding of the situation in CAR during the first year of the COVID-19 pandemic. The COVID-19 epidemiologic data show similar aspects to that globally, including higher incidence among elderly populations, and similar clinical presentations as other countries [29–31]. Furthermore, as in many other low-income countries, testing capacity was limited with high test positivity rate showing a bias towards testing those who were symptomatic as well as foreigners and travelers that required testing to arrive and leave the country. Some differences included a higher number of men getting tested than women, with a consequent higher incidence rate reported amongst men. This discrepancy could be due to more men traveling out of the country than women and a bias towards men having better access to COVID-19 testing than women.

There is a discrepancy between the number of reported COVID-19 cases from this study, regardless of whether the lowest or the highest estimate is considered, and the results of the only serosurvey (to our knowledge) conducted in Bangui over the months of July-August 2021 [32]. The estimated seroprevalence reaches 74.1% of the population, pointing to a very high proportion of the population with anti-SARS-CoV-2 antibodies despite vaccination starting on May 21, 2021. While the serosurvey was conducted after the end of our study period, only a few thousand more cases were officially reported by August 31, 2021 (precisely a cumulative number of cases of 11,307 [33]). A seroprevalence of 74% in Bangui would correspond to circa 666,000 cases, which is 60 times higher than the reported cases. Several factors have likely contributed to this underreporting. First, testing capacity was limited, and for months it was only available at Pasteur Institute and National Laboratory. Furthermore, from July 2020 testing strategy targeted only suspected cases and people at risk, which excludes the majority of the population from testing and automatically underestimates the real case count [24]. MoH data [34] reported 40,541 conducted tests by March 31, 2021, which likely included both National Laboratory and Pasteur testing capacity. While this is higher than what we could estimate based only on data from Pasteur Institute, this corresponds to 824 tests/100,000 and to a 13% positivity rate (above the recommended 5% by WHO [35]), which has been considered as a sign that there is sufficient testing capacity for the given outbreak. Additional access barriers the fear of testing positive and having to comply with preventative measures. Furthermore, primary data showed that the concept of an “asymptomatic case” was poorly understood. This low level of awareness combined with a high proportion of asymptomatic cases in a young population also likely contributed to low testing rates among the general population. Rather, testing was likely concentrated among those who were very sick or who had to be tested (travelers) and could afford it (foreigner travelers). With regard to cost, PCR testing was free at the National Laboratory up to early 2021, when travelers started having to pay. On the contrary, testing was never free at Pasteur Institute. Only at the end of 2021 Health Districts received rapid diagnostic tests that allowed decentralized testing capacity.

How the pandemic has 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, and how risk communication and community engagement (RCCE) programs

were created and implemented [36, 37]. We studied health care utilization of the population in CAR using ITS models with data during the first year of the COVID-19 pandemic as well as qualitative methods amongst HCWs and citizens of CAR. We found a reduction in overall OPD health consultations, and specifically for RTIs and for ANC. These were noted in qualitative interviews as well as observed in the quantitative data.

Although the results are not statistically significant, likely due to limited available data and high variability pre- and during COVID-19 pandemic data, decreasing trends for these indicators were seen in the majority of the districts we studied in CAR. This is corroborated by fewer study participants reporting being sick and seeking care during COVID-19 than in 2021 when data were collected. While no other studies have been conducted in CAR that could provide further understanding of our findings, similar results have been found in other low- and middle-income countries [27,28] as well as few humanitarian settings [40]. The fear of testing positive and having to comply with related restrictions was the main obstacle to seeking health care, and this was reported both among HCWs and community members. Similar perceptions and fears were experienced in other countries across the globe [41–43]. In addition, various measures and adaptations implemented in each health facility may have influenced the individual decision to seek or postpone care in ways that are difficult to predict. For example, small health facilities with limited resources may have had less capacity to set up triage systems or hand washing stations or enforce preventative measures. This might have represented a deterrent for certain community members (such as the elderly) or an incentive for others (maybe those who could not afford being out of work if tested positive, or maybe the younger healthier population who may have been less worried to contract the disease in a health facility). As seen in other epidemics [44], trust and a welcoming approach in a given health facility may play a larger role than preventative measures in guiding individual choice. HCWs reported that violence and population displacement following presidential elections impacted the capacity to implement COVID-19 measures that were implemented at the country level including physical distancing, mask wearing, handwashing or hand friction with hydroalcoholic gel, closure of schools, churches, mosque and shops, ban on gatherings of more than 15 people, remote working/teleworking, limiting the number of patients in the waiting room. Furthermore, a lack of medicine and of qualified health personnel as well as financial barriers were additional important reasons why people reported not seeking care even when sick. The 2021 CAR Humanitarian Needs Overview defined “health care as a precious commodity that many families can no longer afford” [45].

The reduction in consultations for RTIs has been observed in several countries worldwide (among others, Vietnam, Uganda, Kenya, Zambia, and China) [46–50] as well as in refugee settings in Jordan and Uganda [51, 52]. This is likely due to a variety of reasons, ranging from changes in health seeking behaviors due to difficulty to reach health facilities or fear of being infected; to an effective reduction in common RTIs thanks to COVID-19 related preventative measures such as masks, physical distance, and school closure.

Health facilities located in different parts of town may have been affected differently. For example, those closer to markets may have seen a stronger reduction in attendance when movement restrictions were in place. Facilities in urban areas were likely more affected than facilities in rural areas, as enforcement of movement restrictions was likely higher. This is reflected in the survey results, showing more respondents from rural areas reporting seeking care during the first months of COVID-19 restrictions compared to

urban respondents. The opposite was true at the time of data collection, possibly pointing to easier access in urban areas under “normal” conditions. Task and resource shifting towards COVID-19 prevention and treatment activities was also reported in several health facilities. This led to the reduction in the provision of other services or increased waiting time. For example, the frequency at which ANC was offered at health facilities was reported to have decreased during the first months of the pandemic, and community outreach activities first stopped at the beginning of the pandemic and then focused primarily on COVID-19, likely reducing awareness of other health needs or routine services. As in many other countries, health facilities in CAR where HCWs fell sick with COVID-19 struggled to maintain health service provision. These are all signs of a low health system resilience where health facilities have no absorptive or limited adaptive capacity following a shock [53]. We found few health program adaptations that were implemented to maintain health services. Rather external factors related to COVID-19 affected service provision with minimal capacity of health facilities to mitigate its impact.

Interestingly, cold chain and the overall delivery of routine child vaccinations was not reported as being interrupted. On the contrary, quantitative results showed an increase in doses provided at the beginning of the pandemic, results that are difficult to explain. The majority of respondents stated that they did bring their children for routine vaccination at the health centers, even during the first months of the pandemic. However, implementation of two vaccination campaigns (against measles and Td) was delayed by a few months, and a vaccination campaign against polio was cancelled and not reinstated [54]. However, several other campaigns (against Td and polio) were delayed in 2021, not because of COVID-19, but rather because of lack of funding or other implementation constraints (including post-election violence that postponed a second round of a Td campaign end of 2020) [55].

Consultations for other health needs (family planning, malaria and deliveries) showed inconsistent quantitative trends across districts, with some districts reporting an increase and some a decrease in consultations. Health care providers also reported mixed perceptions about the same services. For example, demand for contraception products was perceived as increased by some providers, possibly due to the lockdown with increased sexual activity and the related fear for unwanted pregnancies. This is in line with other conflict affected settings [56]. Other health providers reported a reduction in family planning consultations due to movement restrictions, drug shortages due to border closures, and fear of being infected with COVID-19 if they went to the health facility. Similarly, varying effects were reported for deliveries, where either no utilization changes were observed, or a decrease was noted due to a perceived increase in home deliveries. While an increase in home deliveries was reported among refugee women in Uganda [57], no changes in deliveries were reported in Yemen [40], and limited to no decrease in DRC nationally [36] and in Kinshasa specifically [58]. Disruptions, although smaller than for other services, have been seen in other low- and middle-income countries [36, 59]. A mix of factors such as high heterogeneity within districts, low number of absolute services provided, and individual choices may have contributed to such mixed results that are difficult to interpret.

While the overall changes in the various health services utilized and how they altered over time may differ according to type of disease and geographic coverage due to a variety of factors, it is clear that reductions did occur with varying degrees of restoration over time. These reductions in provision, access and utilization of health services represent an impediment towards universal coverage of essential

interventions [59]. Furthermore, their effects may be more serious amongst populations living in fragile and conflict-affected settings.

Knowledge about the disease, transmission pathway, and higher risk groups was high among adults in Bangui and its surroundings, which is in line with findings from a systematic review of Knowledge, Attitude and Practices (KAP) surveys from several African countries [60]. One year into the pandemic, these results suggest that inhabitants of Bangui and its surroundings sufficiently accessed quality information. Rural populations and IDPs were often less informed about COVID-19 related issues than urban populations and resident communities, although results were not statistically significant. While it has been noted that urban populations were often better informed than rural populations in some countries [61–63], results have been inconsistent in our sample. Furthermore, there is insufficient information on the knowledge of IDPs. The few existing studies from North Kivu, DRC [64], Somalia [65] and Syria [66] highlight the low level of knowledge and high vulnerability of IDPs. While we were not able to include a sufficient sample of IDPs in our study, the situation of IDPs in CAR is likely similarly problematic. This is an important area that needs more investigation and likely a concerted effort to ensure that harder to reach populations, like displaced persons, are actively targeted for specific RCCE messages. Finally, the timing of the survey likely plays a role, as the results may have been quite different earlier in the pandemic. For examples, studies conducted in the first months of the pandemic (March to May 2020) in Katanga and Kinshasa, DRC [67, 68] and conflict affected areas of Cameroon [69], reported much lower level of knowledge.

We noted an important discrepancy between knowledge (high), reported general practices (high) and specific implementation of a protective measure in a concrete encounter (very low). For example, masks were known to be one of the main preventative measures, and the majority of the population reported wearing them during the COVID-19 restriction months. However, masks were reported to be barely worn during meetings that happened the day before the survey. While older community members and those with increasing levels of knowledge were more likely to report wearing a mask, people working in agriculture and internally displaced were much less likely. This may reflect lower levels of perceived risks (agriculture workers may spend more time outside), or lower access to masks. Mask adherence in African countries has been quite volatile with level of compliance ranging from 94% in Mozambique [70], 51% in Somalia [71], Sudan 46% [72], 43% in DRC [73], to 32% in Uganda [71]. However, these studies were web-based, and possibly have a higher risk for social desirability bias. Other observational studies reported varying results too, including 48% in Zambia [74] and 71.5% in Ghana [75].

Multiple factors likely contributed to the limited use of masks, including financial barriers, social perceptions, peer pressure and personal discomfort; these factors have been reported also in other LMIC settings (Pakistan [76]; Ethiopia [77]; Indonesia [78]). Understanding how cultural values influence perceptions is instrumental for effective behavior changes, as guidance or knowledge do not appear to suffice. To consider is also the timing of the survey, which occurred during a period of low incidence rate and when preventative measures were not in place. Yet, given the low vaccination coverage, risk of infection was still high in CAR and protective measures could have been beneficial. While mask mandates have been found to increase the chances of wearing a mask in other settings [79, 80], some reticence in wearing masks or complying with governmental restrictions may also be related to the perception that measures were decided in a top-down manner, with no involvement of the communities in their

definitions. This has been reported also in North Kivu, DRC [56]. Perception that COVID-19 does not exist and that was rather invented by the government can also reduce the willingness to adhere to preventative measures. Low institutional trust has been found to be a barrier to compliance both during COVID-19 [81, 82] and previous Ebola epidemics [83]. The difficulty to believe in the severity of the disease was further exacerbated by the limited proportion of people who knew a person who had COVID-19. Personal experience of symptoms or direct knowledge of a case has been linked in other studies to increased awareness [84]. COVID-19 was reported as "not visible" in a study in North Kivu, DRC, where it was difficult to sensitize communities about its severity and related preventative measures [56].

These factors point towards the importance of community engagement to increase awareness and trust in the epidemic response. RCCE has become a central component of outbreak response strategies since the Ebola epidemic in west Africa [85, 86] but implementation is still challenging. A review of RCCE strategies for COVID-19 in African countries [37] noted how distrust in government, limited health system capacity and resources, widespread rumors and the need to adapt communication mechanisms to reach the most vulnerable communities undermine the effectiveness of RCCE programs, and therefore of the entire response. For example, the main reason for vaccine hesitancy has been the fear for side effects. While this is in line with other studies conducted in LMIC [87–89], it also points to the need for clear information from trusted sources about vaccine efficacy and safety. In the study context, radio and health care professionals were reported as the most trusted information sources, therefore suggesting channels through which communication should be provided. Given the quite high willingness to be vaccinated that was reported by the study population (also in line with other LMIC), especially among internally displaced and rural populations, investments in communication campaigns to build upon this positive attitude would lead to higher return than in countries where hesitancy is higher. The overall positive attitude towards vaccinations could be leveraged by providing targeted information addressing side effects and other rumors.

With regard to social interactions both before and during an outbreak, little evidence exists from low and middle income countries about social dynamics and their implications for the spreading of infectious diseases [90, 91]. 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 high income countries and therefore not reflecting the situation in LMIC. Even rarer is evidence from humanitarian settings [92]. A few social contact surveys have been conducted since the beginning of the pandemic, of which only four originate from non-high income countries. Our case studies therefore significantly increase the available evidence [93].

Changes in behaviors at the beginning of the COVID-19 restrictions were reported regarding meeting duration (which were reported to be shorter), frequency (less frequent or stopped completely) and participants (mainly with/ among younger people to protect the elderly). Furthermore, schools were closed, and religious events were either canceled or their size reduced, limiting the number of people who could attend. The emotional implications of such changes, especially for the elderly population, were reported by the populations, and implied feelings of exclusion and loneliness.

Few interactions were reported among the study participants compared to a recent study across several African countries (which however does not include CAR) [94]. This result is unexpected given that data

were collected at a moment when restrictions were not in place. Interactions were mainly with adults and the average number did not decrease with age. Interactions were mainly at the respondent's or the contact's homes while meetings in public places such as restaurants or other places for leisure activities were very rare. These results align with findings from a review summarizing pre-COVID-19 social interactions in both high and low income countries (CAR however is not included) [90]. They also have important implications for the effectiveness of preventative measures aiming to restrict mobility in settings where, however, 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 behavior that are highly understudied, therefore representing an important contribution to the literature about CAR and about humanitarian settings in general. Furthermore, primary data from CAR are rare given the complexity of implementing data collection. Finally, as the electronic routine health information system is still being rolled out and not available for historic data, analysis of routine health data from CAR is very rare too.

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 extensive data challenges, specifically for the epidemiological analysis and the assessment of changes in health care utilization, make it difficult to have a clear picture of the situation.

Starting with the COVID-19 epidemiology, a first consideration relates to the number of reported cases. As of March 31, 2021 the number of reported cases ranged from 5,161 [1] [JHU] through 5,285 [34] [MoH] up to 6,316 [95] or 6,360 [33] [both WHO]. The two line lists we analyzed include a similar number of cases (3,339 Nat Lab vs 3,992 Pasteur], yet they are difficult to align with the other estimates. As the sum of cases from the two line lists [7,331 cases] is higher than all the total estimates, this suggests that some people were tested in both laboratories. The impossibility to link line lists due to the lack of identifiable information does not allow us to exclude duplicates. As the line lists did not include data on the disease outcomes, we are not able to compare line list data with reported number of deaths (73 according to MoH [34] and 72 as per WHO [95]). Number of deaths align better than number of cases.

Given the complexity of setting up a COVID-19 specific reporting system from the laboratories to the district health offices and up to national MoH and then to WHO, a discrepancy of around 1,000 cases over the 12 months under study may be considered as acceptable (although this is subjective as there are no criteria for such classification). Delays in response and inconsistencies in reported numbers have characterized previous epidemics [96, 97] as well as the COVID-19 epidemic worldwide [98]. Multiple COVID-19 data reporting systems were set up at the beginning of the pandemic [99], characterized by varying tools, guidelines, timeline, responsibilities, etc. Reporting across levels within a given country (i.e., from health facility to local authority to national level), or between actors working in the same country (as we saw in CAR), or among actors at global level (for example between the MoH and WHO) was therefore very challenging, especially the first months of the pandemic. Several factors contributed to causing such discrepancies including differences in definitions (of tests, cases and deaths), delays in test results and reporting, differences in data aggregation and reporting guidelines, reporting flows, data availability. In the case of CAR, the existence of two different line lists introduced variability from the very beginning and likely led to discrepancies and delays. Different operating procedures with regard to when to report (daily, weekly), case definitions, how to adjust case count in case of a delayed test result,

approval process, etc, may have contributed to such differences. The two lines lists were eventually combined in 2021.

A significant challenge in CAR is the lack of accurate population data. Population estimates of permanent settlements are inaccurate, as the most recent governmental census was conducted in 2003. Displacement data are often out of date as internal displacement in CAR is very fluid. In Bangui, to maximize the reliability of population data regarding displacement sites, data collection teams carried out cross-checking trips in the city to verify the existence and the size of targeted displacement sites. This led to the resampling of several sites, either those which were targeted but no longer existed, or those which exist but had not been targeted. Throughout the data collection in all study areas, resampling was conducted continually to compensate for settlements which were inaccessible to data collection teams. In Bimbo, certain large displacement sites were found to be empty when teams arrived. Displacement camps of comparable size could not be identified and therefore these surveys were not replaced. This led to the increased margin of error for displaced population mentioned above.

The geographical scope of this study is important. CAR is a country characterized by strong regional differences. There is, therefore, no guarantee that the results in the urban areas studied here apply to other urban centers in CAR. Nor can the results in rural areas in Bimbo and Bégoua, which are relatively close to the capital, necessarily be applied to more isolated zones such as the Far North or the South East.

Finally, the temporality of this research limits the details of the findings. Data collection was conducted over one year after the end of COVID-19 restrictions in CAR, and several months after a second wave of COVID-19 infections where there were no government restrictions. The time and events that have passed between COVID-19 restrictions and data collection made it difficult for respondents to remember details about the period of restrictions, and to clearly divide the time periods (before restrictions, during restrictions, and after restrictions) in their responses. Recall and social desirability biases can therefore not be excluded

Routine health data were not available in an electronic format, rather had to be manually collected from the monthly reports submitted by the health facilities to the district office. Both reporting disruptions and archiving issues may have contributed to the varying level of completeness across years and districts. Heterogeneity was important for some indicators and districts, as likely several factors affected health service provision during the study period.

7 Conclusions and Recommendations

7. **Policies and their implementation**

Policies addressing important aspects of access to COVID-19 testing and health care need to be considered and addressed, as feasible, for the current COVID-19 epidemic and future epidemics. For example, violence and population displacements following presidential elections likely affected access to health services as well the local capacity to implement COVID-19 measures that were being implemented at the country level. Financial barriers were important factors limiting COVID-19 testing and health care access. Furthermore, small health facilities with limited resources may have had less capacity to establish triage systems, hand washing stations and to enforce preventative measures, and health facilities located in different parts of town may have been affected differently. Task and resource shifting towards COVID-19 prevention and treatment activities was also reported in several health facilities. This led to the reduction in the provision of other services and increased waiting times. As in many other countries, health facilities struggled to maintain health service provision in CAR where HCWs fell sick with COVID-19. These are all signs of a low health system resilience where health facilities have limited adaptive capacity following a shock. We found few health program adaptations that were implemented to maintain health services. Rather external factors related to COVID-19 affected service provision with minimal capacity of health facilities to mitigate its impact.

The fear of testing positive and having to comply with related restrictions, such as isolation and quarantine, as well as paying for such tests, were some of the main obstacles to seeking health care, and need to be addressed to ensure people will get tested and ultimately treated in health care facilities as appropriate.

The various policies and the variations of their implementation stated above show both the direct and indirect intended and unintended effects of the various policies implemented in CAR. They provide future direction when considering which policies to implement in different contexts and locales.

8. **Diseases testing capacity and strategies**

Results of the COVID-19 testing show that a higher number of men were tested than women, with a consequent higher incidence rate amongst men. This discrepancy could be due to more men traveling out of the country than women and a bias towards men having better access to COVID-19 testing than women. However, the number of tests were limited, and consequently, interpretation must be done cautiously.

In the future, CAR should ensure testing capacity for COVID-19 and future diseases of epidemic potential is quickly scaled-up at the beginning of an epidemic, as feasible, to better understand the epidemiology of the disease. Outreach to women should occur. Furthermore, a clear disaggregation and consequent analysis of the testing results should be undertaken, including differentiation by reason for getting tested (those being tested for travel, those with symptoms, contacts of positive cases, etc).

If such rapid scale-up of testing is not possible or insufficient, a limited number of tests should be undertaken to have a representative sample of tests that will improve initial understanding of disease epidemiology and case fatality rates. 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.

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.

9. Health systems data management

There is a need to improve and standardize forms and methods of data collection before the epidemic occurs in CAR, e.g., contact tracing, testing, patient records, will allow for improved understanding of the epidemic and allow for more informed policies and programs.

A focus on pre-existing health information systems as well as specifics systems for the disease of epidemic potential should occur to ensure that robust data are available for epidemic response as well as to ensure that existing health services are continued.

Data should be disaggregated according to sex, age, displacement status, employment, location and travel, among other factors; other issues like ethnic and religious groups may be important as well, while ensuring data protection while considering political and cultural sensitivities.

A simple and reliable data dashboard with trends over time is needed.

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

Knowledge about the disease, transmission pathway, and higher risk groups was high among adults in Bangui and its surroundings, which is in line with findings from a systematic review of KAP surveys from several African countries. One year into the pandemic, these results suggest that inhabitants of Bangui and its surroundings sufficiently accessed quality information. We were not able to include a sufficient sample of IDPs in our study. However, the qualitative results of the study show that the situation of IDPs in CAR is likely problematic; rural populations and IDPs were often less informed about COVID-19 related issues than urban populations and resident communities, although results were not statistically significant. This is an important area that needs more investigation and likely a concerted effort to ensure that harder to reach populations, like IDPs and rural population, are actively targeted for specific RCCE messages.

There was an important discrepancy between knowledge (high), reported general practices (high) and specific implementation of a protective measure in a concrete encounter (very low). For example, masks were known to be one of the main preventative measures, and the majority of the population reported wearing them during the COVID-19 restriction months. However, masks were reported to be barely worn during meetings that happened the day before the survey. Multiple factors likely contributed to the limited use of masks, including financial barriers, social perceptions, peer pressure and personal

discomfort. While mask mandates have been found to increase the chances of wearing a mask in other settings, some reticence in wearing masks or complying with governmental restrictions may also be related to the perception in our survey that measures were decided in a top-down manner, with no involvement of the communities. These factors point towards the importance of community engagement to increase awareness and trust in the epidemic response.

There is a need to implement 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.

Adaptation of RCCE programs according to data and evidence collected should occur. Data showed that knowledge about the disease, transmission pathway, and higher risk groups was high among adults in Bangui and its surroundings, but rural populations and IDPs were less informed about COVID-19. In the study context, radio and HCWs were reported as the most trusted information sources, therefore suggesting these channels through which communication should be provided. Given the quite high willingness to be vaccinated that was reported by the study population (also in line with other LMIC), especially among IDPs and rural populations, investments in communication campaigns to build upon this positive attitude would lead to higher return than in countries where hesitancy is higher. The overall positive attitude towards vaccinations could be leveraged by providing targeted information addressing side effects and other rumors.

A limited number of social contact surveys have been conducted since the beginning of the pandemic. In our survey, Interactions were mainly with adults and the average number did not decrease with age. Interactions were mainly at the respondent's or the contact's homes while meetings in public places such as restaurants or other places for leisure activities were rare. There were many positive aspects regarding COVID-19 among the communities in CAR. Positive changes in behavior were reported, limited number of persons attended religious events, and fewer interactions with persons outside of the family occurred. These, together with an overall positive attitude towards childhood vaccines and the COVID-19 vaccine in CAR appears to be higher than many other countries. This positive attitude should be built upon for other RCCE programs. Furthermore, ensuring there is sufficient supply of COVID-19 vaccines for all persons in CAR should occur.

11. Health care access and utilization

The study found a reduction in overall OPD health consultations, specifically for RTIs and for ANC. These were noted in qualitative interviews as well as observed in the quantitative data. The reduction in consultations for RTIs has been observed in several countries as well as in refugee settings in Jordan and Uganda. This is likely due to a variety of reasons, ranging from changes in health seeking behaviors due to difficulty to reach health facilities or fear of being infected; to an effective reduction in common RTIs thanks to COVID-19 related preventative measures such as masks, physical distancing, and school closures. The majority of respondents stated that they did bring their children for routine vaccination at

the health centers, even during the first months of the pandemic. However, implementation of some vaccination campaigns were delayed possibly by COVID-19, but also due to lack of funding.

While the overall changes in the various health services utilized and how they altered over time may differ according to type of disease and geographic coverage due to a variety of factors, reductions did occur with varying degrees of restoration over time. These reductions in provision, access and utilization of health services represent an impediment towards universal coverage of essential interventions. Furthermore, their effects may be more serious amongst populations living in fragile and conflict-affected settings.

There is a need to Improve understanding of health care access and utilization during the epidemic considering the ITS data that showed a reduction in overall OPD health consultations, and specifically for RTIs and for ANC, as well as differences amongst urban and rural populations in CAR. Further investigation into delivery of childhood vaccinations as well as other health needs such as family planning, malaria and deliveries should occur to better understand what happened during the pandemic, and consequently inform programming. The analysis will include qualitative and quantitative studies to better understand changes in health provision and quality of services as well as community perceptions. This will allow for improved health service and RCCE programs in the current period as well as for future epidemics.

12. Data triangulation

Triangulation of disease specific data, health systems data, and community-based data is essential for analysis and interpretation to inform strategies and programs.

8 References

[1] Johns Hopkins Coronavirus Resource Center. COVID-19 Dashboard, https://coronavirus.jhu.edu/map.html (2020, accessed 12 May 2021).

[2] Cameron E, Nuzzo JB, Bell J. *Global Health Security Index*, https://www.ghsindex.org (2019).

[3] IFRC, IOM, UNHCR, et al. *Interim Guidance on Scaling-up COVID-19 Outbreak in Readiness and Response Operationa in camps and camp-like settings*. Geneva, https://interagencystandingcommittee.org/other/interim-guidance-scaling-covid-19-outbreak-readiness-and-response-operations-camps-and-camp (2020).

[4] Lau LS, Samari G, Moresky RT, et al. COVID-19 in humanitarian settings and lessons learned from past epidemics. *Nature Medicine* 2020; 26: 647–648.

[5] Gilbert M, Pullano G, Pinotti F, et al. Preparedness and vulnerability of African countries against importations of COVID-19: a modelling study. *Lancet* 2020; 395: 871–877.

[6] Truelove S, Abrahim O, Altare C, et al. The potential impact of COVID-19 in refugee camps in Bangladesh and beyond: a modeling study. *PLOS Med*; June 16. Epub ahead of print 2020. DOI: https://doi.org/10.1371/journal.pmed.1003144.

[7] United Nations Office for Coordination of Humanitarian Affairs (OCHA). COVID-19 Pandemic in Locations with a Humanitarian Response Plan, https://data.humdata.org/event/covid-19 (2020, accessed 21 November 2020).

[8] Tessema SK, Nkengasong JN. Understanding COVID-19 in Africa. *Nat Rev Immunol 2021 218* 2021; 21: 469–470.

[9] Adams J, MacKenzie MJ, Amegah AK, et al. The Conundrum of Low COVID-19 Mortality Burden in sub-Saharan Africa: Myth or Reality? *Glob Heal Sci Pract* 2021; 9: 433–443.

[10] Musa H, Musa T, Musa I, et al. Addressing Africa's pandemic puzzle: Perspectives on COVID-19 transmission and mortality in sub-Saharan Africa. *Int J Infect Dis* 2021; 102: 483–488.

[11] Elston JWT, Cartwright C, Ndumbi P, et al. The health impact of the 2014–15 Ebola outbreak. *Public Health* 2017; 143: 60–70.

[12] Singh NS, Abrahim O, Altare C, et al. COVID-19 in humanitarian settings: documenting and sharing context-specific programmatic experiences. *Conflict and Health*; 14. Epub ahead of print 1 December 2020. DOI: 10.1186/s13031-020-00321-w.

[13] Odlum A, James R, Mahieu A, et al. Use of COVID-19 evidence in humanitarian settings: the need for dynamic guidance adapted to changing humanitarian crisis contexts. *Confl Health*; 15. Epub ahead of print 1 December 2021. DOI: 10.1186/s13031-021-00418-w.

[14] World Health Organization. Weekly epidemiological update on COVID-19 - 30 March 2021, https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---31-march-2021 (2021, accessed 1 December 2022).

[15] United Nations Department of Economic and Social Affairs Population Division. World Population Prospects. *Custom data acquired via website*, https://population.un.org/wpp/DataQuery/ (2019, accessed 4 May 2022).

[16] United Nations Office for Coordination of Humanitarian Affairs. *Humanitarian Needs Overview 2022 - Central African Republic*, moz-extension://e3991478-5c68-2747-9922-

285438e58017/enhanced-reader.html?openApp&pdf=https%3A%2F%2Fwww.humanitarianresponse.info%2Fsites%2Fwww.humanitarianresponse.info%2Ffiles%2Fdocuments%2Ffiles%2Fhno_car_2022_final_en.pdf (2021, accessed 13 May 2022).

[17] United Nations High Commissioner for Refugees. Situation Réponse Régionale à la crise centrafricaine, https://data2.unhcr.org/fr/situations/car (accessed 13 May 2022).

[18] United Nations Population Fund. World Population Dashboard: Central African Republic, https://www.unfpa.org/data/world-population/CF (2022, accessed 13 May 2022).

[19] Institut Centrafricain des Statistiques et des Etudes Economiques et Sociales. *MICS: Enquete par grappe à indicateurs multiples 2018-2019,*. 2021.

[20] Institut Centrafricain des Statistiques et des Etudes Economiques et Sociales. *Enquete par grappes à indicateurs multiples - MICS couplée avec la sérologie VIH, RCA, 2010*, https://mics-surveys-prod.s3.amazonaws.com/MICS4/West and Central Africa/Central African Republic/2010/Final/Central African Republic 2010 MICS_French.pdf (2012, accessed 13 May 2022).

[21] United Nations' Children Fund. *Coronavirus (COVID-19) Situation Report N 1*. Bangui, https://www.unicef.org/media/78956/file/Central-African-Republic-COVID-19-SitRep-15-April-2020.pdf (2020, accessed 29 November 2022).

[22] African Regional Organisation of the International Trade Union Confederation. La gestion de la crise du Covid-19 en Centrafrique. *ituc-africa.org*, https://www.ituc-africa.org/La-gestion-de-la-crise-du-Covid-19-en-Centrafrique.html (2020, accessed 29 November 2022).

[23] United Nations. *CENTRAL AFRICAN REPUBLIC: UN COVID-19 SOCIO-ECONOMIC RESPONSE PLAN*. Bangui, https://minusca.unmissions.org/en (2020, accessed 29 November 2022).

[24] United Nations Office for Coordination of Humanitarian Affairs (OCHA). *Two years after the Central African Republic confirmed the first COVID-19 case*. Bangui, https://reports.unocha.org/en/country/car/card/3lzOEAosRF/ (2022, accessed 29 November 2022).

[25] Balduzzi S, Rücker G, Schwarzer G. How to perform a meta-analysis with R: a practical tutorial. *Evid Based Ment Health* 2019; 22: 153–160.

[26] Deeks J, Higgins J, Altman D. Chapter 10: Analysing data and undertaking meta-analyses. In: *Cochrane Handbook for Systematic Reviews of Interventions*, https://training.cochrane.org/handbook/current/chapter-10#_Ref180060313 (2022, accessed 10 August 2022).

[27] Wood SN. Fast stable restricted maximum likelihood and marginal likelihood estimation of semiparametric generalized linear models. *J R Stat Soc Ser B (Statistical Methodol* 2011; 73: 3–36.

[28] Gale NK, Heath G, Cameron E, et al. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol* 2013; 13: 117.

[29] Salzberger B, Buder F, Lampl B, et al. Epidemiology of SARS-CoV-2. *Infection* 2021; 49: 233–239.

[30] Starke KR, Reissig D, Petereit-Haack G, et al. The isolated effect of age on the risk of COVID-19 severe outcomes: a systematic review with meta-analysis. *BMJ Glob Heal* 2021; 6: e006434.

[31] Salajegheh Tazerji S, Shahabinejad F, Tokasi M, et al. Global data analysis and risk factors

associated with morbidity and mortality of COVID-19 ☆. *Gene Reports*; 26. Epub ahead of print 2022. DOI: 10.1016/j.genrep.2022.101505.

[32] Manirakiza A, Malaka C, Yambiyo BM, et al. Very high relative seroprevalence of anti-SARS-CoV-2 antibodies among communities in Bangui, Central African Republic. *medRxiv*. Epub ahead of print 21 November 2021. DOI: 10.1101/2021.11.18.21266496.

[33] World Health Organization. Central African Republic - Statistics, https://www.who.int/countries/caf/ (accessed 23 September 2022).

[34] Ministère de la santé et de la population. *Rapport de situation journaliere de COVID-19 en république Centrafricaine - SitRep n 340*, http://msp-centrafrique.net/docs_pdf/SITE_REP/SITREP_N340du0104.2021.pdf (2021, accessed 23 September 2022).

[35] World Health Organization. *Public health criteria to adjust public health and social measures of COVID-19*. Geneva, https://apps.who.int/iris/bitstream/handle/10665/332073/WHO-2019-nCoV-Adjusting_PH_measures-Criteria-2020.1-eng.pdf?sequence=1&isAllowed=y (2020, accessed 23 September 2022).

[36] Shapira G, Ahmed T, Drouard SHP, et al. Disruptions in Essential Health Services During the First Five Months of COVID-19: Analysis of Facility-Reported Service Volumes in Eight Sub-Saharan African Countries. *Health Policy Plan* 2021; 36: 1140–1151.

[37] Adebisi YA, Rabe A, Lucero-Prisno DE. Risk communication and community engagement strategies for COVID-19 in 13 African countries. *Heal Promot Perspect* 2021; 11: 137.

[38] Ahmed TI, Roberton T, Vergeer P, et al. Healthcare utilization and maternal and child mortality during the COVID-19 pandemic in 18 low- and middle-income countries: An interrupted time-series analysis with mathematical modeling of administrative data. *PLOS Med* 2022; 19: e1004070.

[39] Arsenault C, Gage A, Kim MK, et al. COVID-19 and resilience of heathcare systems in ten countries. *Nat Med* 2022; 28: 1314–1324.

[40] Kotiso M, Qirbi N, Al-Shabi K, et al. Impact of the COVID-19 pandemic on the utilisation of health services at public hospitals in Yemen: a retrospective comparative study. *BMJ Open* 2022; 12: 47868.

[41] Kamoga MRN. Covid-19: Patient voices and perspectives in Uganda - The BMJ. *The BMJ Opinion*, https://blogs.bmj.com/bmj/2020/08/06/covid-19-patient-voices-and-perspectives-in-uganda/ (2020, accessed 19 August 2022).

[42] Adu PA, Stallwood L, Adebola SO, et al. The direct and indirect impact of COVID-19 pandemic on maternal and child health services in Africa: a scoping review. *Glob Heal Res Policy* 2022; 7: 1–14.

[43] Singh DR, Sunuwar DR, Shah SK, et al. Impact of COVID-19 on health services utilization in Province-2 of Nepal: a qualitative study among community members and stakeholders. *BMC Health Serv Res* 2021; 21: 1–14.

[44] Tibbels N, Hendrickson Z, Mills H, et al. The Salience of Trust to the Client-Provider Relationship in Post-Ebola Guinea: Findings from a Qualitative Study. *Glob Heal Sci Pract*; 10. Epub ahead of print 1 February 2022. DOI: 10.9745/GHSP-D-21-00429/-/DCSUPPLEMENTAL.

[45] United Nations Office of Humanitarian Affairs. *Aperçu des besoins humanitaires: République centrafricaine*,

https://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/documents/files/hno_car_2022_final.pdf (October 2021, accessed 17 August 2022).

[46] Nguyen QT, Dao TL, Pham TD, et al. Effect of the COVID-19 Outbreak on the Incidence of Other Respiratory and Gastrointestinal Infections in Children in Thai Binh, Vietnam in 2020. *J Epidemiol Glob Health* 2022; 12: 182–187.

[47] Burt JF, Ouma J, Lubyayi L, et al. Indirect effects of COVID-19 on maternal, neonatal, child, sexual and reproductive health services in Kampala, Uganda. *BMJ Glob Heal* 2021; 6: 6102.

[48] Wambua S, Malla L, Mbevi G, et al. Quantifying the indirect impact of COVID-19 pandemic on utilisation of outpatient and immunisation services in Kenya: a longitudinal study using interrupted time series analysis. *BMJ Open* 2022; 12: 55815.

[49] Loevinsohn G, Hamahuwa M, Hardick J, et al. Respiratory viruses in rural Zambia before and during the COVID-19 pandemic. *Trop Med Int Heal* 2022; 27: 647–654.

[50] Ye Q, Wang D. Epidemiological changes of common respiratory viruses in children during the COVID-19 pandemic. *J Med Virol* 2022; 94: 1990–1997.

[51] Altare C, Kostandova N, OKeeffe J, et al. COVID-19 epidemiology and changes in health service utilization in Uganda's refugee settlements during the first year of the pandemic. *BMC Public Heal 2022 221* 2022; 22: 1–16.

[52] Altare C, Kostandova N, Okeeffe J, et al. COVID-19 epidemiology and changes in health service utilization in Azraq and Zaatari refugee camps in Jordan: A retrospective cohort study. *PLOS Med* 2022; 19: e1003993.

[53] Blanchet K, Nam SL, Ramalingam B, et al. Governance and Capacity to Manage Resilience of Health Systems: Towards a New Conceptual Framework. *Int J Heal policy Manag* 2017; 6: 431–435.

[54] Ho LL, Gurung S, Mirza I, et al. Impact of the SARS-CoV-2 pandemic on vaccine-preventable disease campaigns. *Int J Infect Dis* 2022; 119: 201–209.

[55] World Health Organization, United Nations' Children's Fund. Immunization repository, https://www.who-immunization-repository.org.

[56] Ho LS, Bertone MP, Mansour W, et al. Health system resilience during COVID-19 understanding SRH service adaptation in North Kivu. *Reprod Heal 2022 191* 2022; 19: 1–10.

[57] Lusambili AM, Martini M, Abdirahman F, et al. "We have a lot of home deliveries" A qualitative study on the impact of COVID-19 on access to and utilization of reproductive, maternal, newborn and child health care among refugee women in urban Eastleigh, Kenya. *J Migr Heal* 2020; 1–2: 100025.

[58] Hategeka C, Carter SE, Chenge FM, et al. Impact of the COVID-19 pandemic and response on the utilisation of health services in public facilities during the first wave in Kinshasa, the Democratic Republic of the Congo. *BMJ Glob Heal* 2021; 6: 5955.

[59] Amouzou A, Maïga A, Faye CM, et al. Health service utilisation during the COVID-19 pandemic in sub-Saharan Africa in 2020: a multicountry empirical assessment with a focus on maternal, newborn and child health services. *BMJ Glob Heal* 2022; 7: e008069.

[60] Nwagbara UI, Osuala EC, Chireshe R, et al. Knowledge, attitude, perception, and preventative practices towards COVID-19 in sub-Saharan Africa: A scoping review. *PLoS One* 2021; 16: e0249853.

[61] Njingu AE, Jabbossung FE, Ndip-Agbor TE, et al. Comparing knowledge, attitudes and practices regarding COVID-19 amongst Cameroonians living in urban versus rural areas. *PAMJ 2021; 38:234*; 38. Epub ahead of print 4 March 2021. DOI: 10.11604/PAMJ.2021.38.234.25964.

[62] Zhang J, Zhu L, Li S, et al. Rural-urban disparities in knowledge, behaviors, and mental health during COVID-19 pandemic: A community-based cross-sectional survey. *Med (United States)* 2021; 100: E25207.

[63] Rahman MS, Karamehic-Muratovic A, Amrin M, et al. COVID-19 Epidemic in Bangladesh among Rural and Urban Residents: An Online Cross-Sectional Survey of Knowledge, Attitudes, and Practices. *Epidemiol 2021, Vol 2, Pages 1-13* 2020; 2: 1–13.

[64] Claude KM, Serge MS, Alexis KK, et al. Prevention of COVID-19 in Internally Displaced Persons Camps in War-Torn North Kivu, Democratic Republic of the Congo: A Mixed-Methods Study. *Glob Heal Sci Pract* 2020; 8: 638–653.

[65] Alawa J, Al-Ali S, Walz L, et al. Knowledge and perceptions of COVID-19, prevalence of pre-existing conditions and access to essential resources in Somali IDP camps: a cross-sectional study. *BMJ Open* 2021; 11: 44411.

[66] Douedari Y, Alhaffar M, Al-Twaish M, et al. "Ten years of war! You expect people to fear a 'germ'?": A qualitative study of initial perceptions and responses to the COVID-19 pandemic among displaced communities in opposition-controlled northwest Syria. *J Migr Heal* 2020; 1–2: 100021.

[67] Kuhangana TC, Mbayo CK, Kitenge JP, et al. COVID-19 Pandemic: Knowledge and Attitudes in Public Markets in the Former Katanga Province of the Democratic Republic of Congo. *Int J Environ Res Public Heal 2020, Vol 17, Page 7441* 2020; 17: 7441.

[68] Akilimali PZ, Mashinda K, Lulebo AM, et al. The emergence of COVID-19 in the Democratic Republic of Congo: Community knowledge, attitudes, and practices in Kinshasa. *PLoS One* 2022; 17: e0265538.

[69] Nicholas T, Mandaah FV, Esemu SN, et al. COVID-19 knowledge, attitudes and practices in a conflict affected area of the South West Region of Cameroon. *Pan Afr Med J* 2020; 35: 34.

[70] Júnior A, Dula J, Mahumane S, et al. Adherence to COVID-19 Preventive Measures in Mozambique: Two Consecutive Online Surveys. *Int J Environ Res Public Heal 2021, Vol 18, Page 1091* 2021; 18: 1091.

[71] Siewe Fodjo JN, Pengpid S, Villela EF de M, et al. Mass masking as a way to contain COVID-19 and exit lockdown in low- and middle-income countries. *J Infect* 2020; 81: e1–e5.

[72] Ayed II, Khalil R, Adam I, et al. Face Mask Practice and Technique During the COVID-19 Pandemic: A Nonrepresentative Cross-Sectional Study in Sudan. Epub ahead of print 2022. DOI: 10.2147/PPA.S366099.

[73] Dinanga Ditekemena J, Nkamba DM, Muhindo HM, et al. Factors associated with adherence to COVID-19 prevention measures in the Democratic Republic of the Congo (DRC): results of an online survey. *BMJ Open* 2021; 11: 43356.

[74] Kateule E, Banda I, Chika M, et al. Cross-sectional study of face mask use during the COVID-19 pandemic-Lusaka and Mansa Districts, Zambia, December 2020. *PAMJ 2022; 41:306*; 41. Epub ahead of print 14 April 2022. DOI: 10.11604/PAMJ.2022.41.306.29854.

[75] Ameme DK, Odikro MA, Baidoo A, et al. Hand hygiene and face mask wearing practices for COVID-19 prevention: a non-intrusive observation of patrons of community convenience shops in Accra,

Ghana. *PAMJ 2021; 40:195*; 40. Epub ahead of print 1 December 2021. DOI: 10.11604/PAMJ.2021.40.195.26195.

[76] Abid KI, Ahmed H, Abdul Bari Y, et al. Perceived barriers to facemask adherence in the covid-19 pandemic in Pakistan-A cross-sectional survey. *PLoS One* 2022; 17: e0267376.

[77] Abeya SG, Barkesa SB, Sadi CG, et al. Adherence to COVID-19 preventive measures and associated factors in Oromia regional state of Ethiopia. *PLoS One* 2021; 16: e0257373.

[78] Klau Fauk N, Liquory Seran A, Raymond C, et al. Why Do We Not Follow Lifesaving Rules? Factors Affecting Nonadherence to COVID-19 Prevention Guidelines in Indonesia: Healthcare Professionals perspectives. *Int J Environ Res Public Heal 2022, Vol 19, Page 8502* 2022; 19: 8502.

[79] Adjodah D, Dinakar K, Chinazzi M, et al. Association between COVID-19 outcomes and mask mandates, adherence, and attitudes. *PLoS One* 2021; 16: e0252315.

[80] Puttock EJ, Marquez J, Young DR, et al. Association of masking policies with mask adherence and distancing during the SARS-COV-2 pandemic. *Am J Infect Control* 2022; 50: 969–974.

[81] Badman RP, Wang AX, Skrodzki M, et al. Trust in Institutions, Not in Political Leaders, Determines Compliance in COVID-19 Prevention Measures within Societies across the Globe. *Behav Sci 2022, Vol 12, Page 170* 2022; 12: 170.

[82] Diallo AI, Faye A, Tine JAD, et al. Factors associated with the acceptability of government measures to address COVID-19 in Senegal. *Rev Epidemiol Sante Publique* 2022; 70: 109–116.

[83] Vinck P, Pham PN, Bindu KK, et al. Institutional trust and misinformation in the response to the 2018–19 Ebola outbreak in North Kivu, DR Congo: a population-based survey. *Lancet Infect Dis*. Epub ahead of print 27 March 2019. DOI: 10.1016/S1473-3099(19)30063-5.

[84] Kwabla MP, Nyasordzi J, Kye-Duodu G, et al. Factors associated with COVID-19 knowledge among Ghanaians: A national survey. *PLoS One* 2022; 17: e0276381.

[85] Gillespie AM, Obregon R, El Asawi R, et al. Social Mobilization and Community Engagement Central to the Ebola Response in West Africa: Lessons for Future Public Health Emergencies. *Glob Heal Sci Pract* 2016; 4: 626–646.

[86] Ngoy N, Conteh IN, Oyugi B, et al. Coordination and Management of COVID-19 in Africa through Health Operations and Technical Expertise Pillar: A Case Study from WHO AFRO One Year into Response. *Trop Med Infect Dis* 2022; 7: 183.

[87] Solís Arce JS, Warren SS, Meriggi NF, et al. COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. *Nat Med 2021 278* 2021; 27: 1385–1394.

[88] Ackah BBB, Woo M, Stallwood L, et al. COVID-19 vaccine hesitancy in Africa: a scoping review. *Glob Heal Res policy* 2022; 7: 21.

[89] Bono SA, Villela EF de M, Siau CS, et al. Factors Affecting COVID-19 Vaccine Acceptance: An International Survey among Low- and Middle-Income Countries. *Vaccines 2021, Vol 9, Page 515* 2021; 9: 515.

[90] Mousa A, Winskill P, Watson OJ, et al. Social contact patterns and implications for infectious disease transmission: A systematic review and meta-analysis of contact surveys. *Elife*; 10. Epub ahead of print 1 November 2021. DOI: 10.7554/ELIFE.70294.

[91] Hoang T, Coletti P, Melegaro A, et al. A Systematic Review of Social Contact Surveys to Inform Transmission Models of Close-contact Infections. *Epidemiology* 2019; 30: 723–736.

[92] Aylett-Bullock J, Gilman RT, Hall I, et al. Epidemiological modelling in refugee and internally displaced people settlements: challenges and ways forward. *BMJ Glob Heal* 2022; 7: 7822.

[93] Liu CY, Berlin J, Kiti MC, et al. Rapid review of social contact patterns during the COVID-19 pandemic. *MedRxiv Prepr*, https://www.medrxiv.org/content/10.1101/2021.03.12.21253410v1.full.pdf (2022, accessed 9 September 2022).

[94] Dobreva Z, Gimma A, Rohan H, et al. Characterising social contacts under COVID-19 control measures in Africa. *BMC Med* 2022; 20: 1–13.

[95] World Health Organization. Central African Republic: WHO Coronavirus Disease (COVID-19) Dashboard With Vaccination Data | WHO Coronavirus (COVID-19) Dashboard With Vaccination Data, https://covid19.who.int/region/afro/country/cf (accessed 23 September 2022).

[96] Hoffman SJ, Silverberg SL. Delays in global disease outbreak responses: Lessons from H1N1, Ebola, and Zika. *Am J Public Health* 2018; 108: 329–333.

[97] Wolfe CM, Hamblion EL, Dzotsi EK, et al. Systematic review of Integrated Disease Surveillance and Response (IDSR) implementation in the African region. *PLoS One* 2021; 16: e0245457.

[98] Cornish L, Jerving S, Lei Ravelo J. Data around COVID-19 is a mess and here's why that matters | Devex. *Devex - Inside Development*, 11 May 2020, https://www.devex.com/news/data-around-covid-19-is-a-mess-and-here-s-why-that-matters-97077 (11 May 2020, accessed 17 August 2022).

[99] Judson SD, Torimiro J, Pigott DM, et al. COVID-19 data reporting systems in Africa reveal insights for future pandemics. *Epidemiol Infect*; 150. Epub ahead of print 2022. DOI: 10.1017/S0950268822001054.

9 Annexes

(Separate file)

9.1 Interview guide for health care workers

9.2 Interview guide focus group discussions

9.3 Interview guide household survey

9.4 Supplementary material to the Interrupted Time Series analysis