The impact of COVID-19 on utilization of hospital services

A case study in rural Sierra Leone

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The impact of COVID-19 on utilization of hospital services; a case study in rural Sierra Leone

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by

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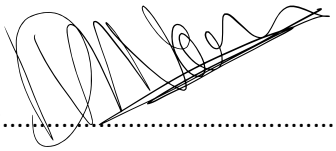
Signature:  .....

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Table of contents

List of tables and figures

Figures

Tables

Graphs

Abbreviations

ANC	antenatal care
ARI	acute respiratory tract infection
COVID-19	Coronavirus disease 2019
HBM	Health Believe Model
HCW	health care workers
HIV	human immunodeficiency virus
ITSA	interrupted time series analysis
LD	lockdown
LHMC	Lion Heart Medical Centre
LMIC	low and middle-income country
MMR	maternal mortality ratio
NCD	non-communicable diseases
OPD	outpatient department
post-LD	post-lockdown
PPE	personal protective equipment
REC	research ethics committee
SARS-CoV-2	severe acute respiratory syndrome-coronavirus-2
TB	tuberculosis
UHC	universal health coverage

Abstract

Introduction: Sierra Leone responded to the COVID-19 pandemic with strict lockdown measures. The Lion Heart Medical Centre, a rural second line health facility, implemented a COVID-19 strategy to respond to the outbreak and continue regular services. This thesis aims to evaluate utilization rates of hospital services related to maternal health, child health, HIV and/or TB and non-communicable diseases and additionally health-seeking behaviour during an outbreak.
Methodology: A retrospective analysis of the utilization of hospital services in 2020 during the lockdown period (April to June) en the period afterwards (July to December) was conducted for different patient groups. Utilization rates are compared with corresponding periods in 2019 and an interrupted time series analysis. Additionally, a review of literature includes health-seeking behaviour during an outbreak guided by the Health Belief Model.
Results: During the three-month lockdown period all services were underutilized, the reduction ranged from 33 to 88%. After the lockdown, acute services including maternal health, restored to normal levels. Services related to child health and chronic conditions and remained below the normal level. The literature review showed that fear and stigma were main driving factors for under-utilization, similar as during the Ebola outbreak.
Discussion: The under-utilization during the lockdown period potentially led to indirect morbidity and mortality. On going under-utilization may be explained by common symptomatology between malaria, respiratory infections, tuberculosis and COVID-19. Strategies to reduce fear and stigma are recommended, particularly aimed at the under-five population. Evaluating indirect effects provides important information to balance future outbreak measures.

Key words: COVID-19, Sierra Leone, utilization, indirect effects, vulnerable populations

Word count: 10 750

1. Introduction

During the initial phase of the Coronavirus disease 2019 (COVID-19) pandemic I worked in rural Sierra Leone as the Medical Officer in charge of a remote hospital, the Lion Heart Medical Centre. The government took rigorous measures to restrict travel movements and to prevent that COVID-19 travelled across the borders into Sierra Leone. In the hospital, we prepared for the pandemic and used the experience and personal protective equipment that had remained after the Ebola outbreak 5 years ago. Together with our team, we saw the number of patients visiting the hospital rapidly decline, even before COVID-19 began to spread in Sierra Leone. We observed that patients were scared, withdrew to their ancestral villages and talked about COVID-19 as if Ebola had returned. People were afraid to attract COVID-19 in hospitals and assumed that the health care system was not functional as it had been during Ebola. Even though we made a serious effort to sensitise and connect to the community via de radio and chiefs as we had been doing for a long time, people were suspicious and avoided the hospital. At the same time, we struggled to keep services up and running because our supply chain was distorted by new regulations imposed by the European Union to control (and restrict) the outgoing supplies of personal protective equipment and other COVID-19 related supplies.
When the lockdown began, it became even more silent in the hospital to a point where we had zero patients left. I can safely say that over the years working in Sierra Leone, I encountered quite some situations that were impressive, awfully sad or dehumanising, beyond imagination. Yet, it is the empty hospital during the COVID-19 lockdown that impressed me most. We kept on wondering what had happened to the little children that were usually packed in the wards while being treated for malaria. What had happened to all the pregnant women that came to our hospital to deliver? What had happened to all our chronically ill patients with diabetes, tuberculosis, HIV or hypertension that would line up to get a refill of their medication? They were surely not in the neighbouring clinics or hospitals because they were nearly empty as well.

This personal experience made a big impression on me as a medical doctor, but also personally. It motivated me to explore and research further what had happened to the utilization of hospital services during the COVID-19 pandemic and, most importantly, to understand why.

2. Background

Sierra Leone is a West African country infamous for its past. During the civil war (1991-2002) the infrastructure in the country was destroyed including the health system (1). In 2014 and 2015, Sierra Leone suffered from the Ebola outbreak which had brought to light that the health system had been severely compromised by the civil war and years of underinvestment (2). Not surprisingly, the Ebola outbreak had a major impact on health of the entire population (3).
Despite efforts to strengthen the health system, health indicators such as maternal and under-five mortality had stagnated and remained among the worst in the world. At present, Sierra Leone ranks among the top three countries with the highest maternal mortality ratio (MMR): 1120 deaths per 100 000 live births (4). The under-five mortality ratio is 101 deaths per 1000 live births (5), meaning that 1 in 10 children does not reach the age of five. Malaria and respiratory tract infections are responsible for a majority of these deaths (6).
The lack of coordination and integration between programmes and facilities in the health network have been identified as main barriers for efficiency, this phenomenon is known as fragmentation of the health system (7). Often this is mainly the result of dependence of external partners who each support a vertical program, for example HIV. After the Ebola outbreak, Sierra Leone received an influx of resources and an increase of partnering organizations. This posed a significant challenge for the health sector to coordinate all programmes and establish a coherence (7).
A well-functioning health system is crucial to achieve universal health coverage (UHC) and respond to a pandemic at the same time. Functionality contains four capacities: access to care, quality of care, demand of essential services and resilience (8). Relative to other countries in the WHO African Region, Sierra Leone ranks among the lower segment in terms of access and resilience capacity and at the middle segment in terms of quality and demand capacity (8).

2.1 Initial phase COVID-19 pandemic in Sierra Leone

As in most countries, the COVID-19 pandemic had a substantial impact on daily life and the health care system in Sierra Leone. Due to the Ebola outbreak in 2014 and 2015 Sierra Leone was already quite experienced in responding to a viral disease endangering public health. Before the first cases of COVID-19 were detected, rigorous measures were taken to halt the spread of the Severe Acute Respiratory Syndrome-Coronavirus-2 (SARS-CoV-2): the airspace and land borders were closed combined with an extensive lockdown period with intermittent periods where people were not allowed to leave their house (9,10). A detailed overview of these key events in the initial phase of the -19 pandemic including a timeline of confirmed cases during 2020, is provided in box 1. Despite the first reports indicating that the majority of SARS-CoV-2 infections caused a mild disease course (11), COVID-19 was presented as a severe disease with high mortality: ‘like Ebola, highly infectious and deadly’ (10).

As described in box 1, the health authorities in Sierra Leone took rapid action and enforced strict lockdown measures (12). This pattern of early, quick and strong measures was observed in countries with previous experience with outbreaks (Ebola), which had limited resources available to direct towards emergencies and their governments had a (realistic) lack of confidence in their health system (13). The measures were aimed at supressing COVID-19 before it could get established. This strategy was seen in many African countries (13). In Sierra Leone, the examples of how COVID-19 affected countries with stronger health systems (Italy e.g.), supported the sense of necessity of this initial response (14).

Box 1: Key events during the initial phase of the COVID-19 pandemic in Sierra Leone

The government announced restrictions to reduce international and national transport rigorously to prevent the spread of COVID-19 to and within Sierra Leone in response to the expanding COVID-19 pandemic to the different continents. From March 21 2020 the airspace was closed down and from March 27 onwards the land border with neighbouring countries were closed (10). In addition, a state of emergency was proclaimed. Despite the restrictions on mobility the inevitable happened; the first positive COVID-19 case was reported on March 31. Subsequently an inter-district lockdown was enforced from April 5 with intermittent periods of complete lockdown where all individuals needed to stay indoors (9). The inter-district lockdown was relieved on June 24 when the number of COVID-19 cases reduced and the feared large-scale morbidity and mortality was not observed (15).

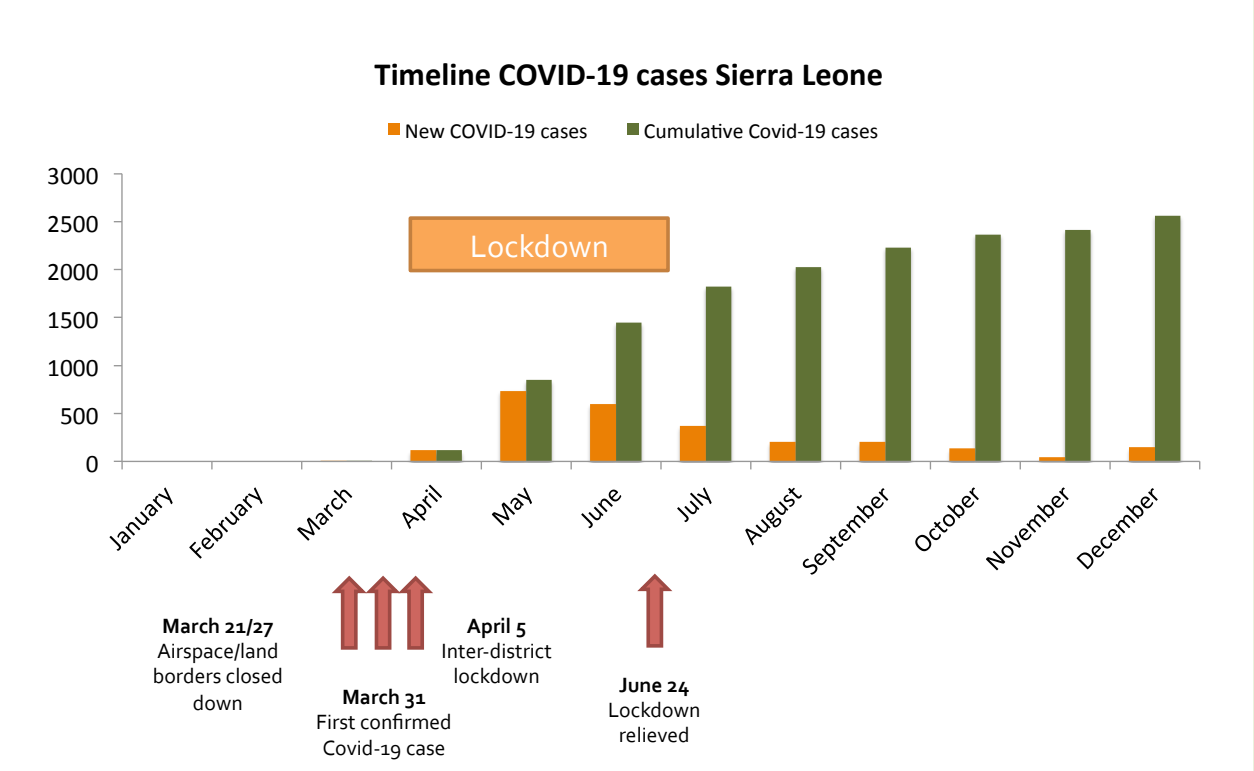


Figure 1: timeline of key events and officially registered confirmed COVID-19 cases in Sierra Leone in 2020 (16).

2.2 The impact of an outbreak

The burden of COVID-19 is inequitable distributed, with low and middle-income countries (LMIC) and poor communities affected more (17). In general, older people, people living in densely populated areas, people with a lower socio-economic status and minority groups are disproportionally affected (17). People living in LMIC's are also more vulnerable to the socio-economic effects of lockdown measures because a large proportion of the population often depends on daily hands-on labour. Families depend on this daily income to buy food for their survival and lockdown measures immediately increase food insecurity (18,19). In Sierra Leone, the strict lockdown measures had an immediate effect on household income, causing difficulties to provide food for the majority. Additionally, high rates of anxiety were reported in these same households (19).

In Sierra Leone, elderly people in the rural areas were found particularly vulnerable during the lockdown period since they often depend on care and support from others that may not live in their household. Due to travel restrictions they became more easily separated from their caregivers an had less access to essential supplies (20). These reports confirm the grave concerns, expressed at the beginning of the pandemic, on the effects of lockdown restrictions on people's ability to feed families and whether the relatively poor population would be able to cope with the lockdown restrictions (12).

An important lesson learned from the Ebola outbreak in West Africa is that the impact on healthcare stretches far beyond the direct morbidity and mortality. This is shown by an overall decrease in uptake of hospital services due to less availability of services combined with fear and stigma (21). Both health care provision and utilization determine the uptake (or coverage) of services. In turn, utilization is influenced by the demand for and access to these services (22). During the Ebola outbreak, people were less inclined to seek health care for a sick family member, indicating a decreased demand (23,24).
At the same time, health facilities were not able to provide good quality healthcare due to a lack of equipment and supplies. This resulted in nosocomial Ebola infections and closure of health institutions leading to a reduced provision of health services (21,25). This corresponds with the main reported barriers to access healthcare: fear to attract Ebola and a disruption of services (26). Other factors influencing access related to transportation were not important barriers (26). Overall, vulnerable groups such as pregnant women, young children, elderly and chronically ill, were most affected by the decrease in uptake of hospital services (3).

2.3 The Lion Heart Medical Centre

In the rural heart of Sierra Leone, the Lion Heart Medical Centre (LHMC) has operated as a second line health facility in Tonkolili district for the past decade. During the Ebola outbreak a dramatic drop in patient attendances was observed, most likely caused by fear in the community to be considered an Ebola suspect and subsequent isolation (27). At the same time it was very difficult to safeguard the functionality of essential services due to staff shortages resulting from nosocomial transmission of Ebola to health care workers (HCW) (27). With the lessons from Ebola in mind, the main aim during the COVID-19 pandemic was to ensure continuation of regular health services and at the same time adequately respond to the threat of COVID-19. From March 2020 onwards the LHMC designed and implemented an appropriate response to the COVID-19 pandemic in close collaboration with the health authorities. An overview of this strategy is given in box 2.

Despite this strategy, the functionality and provision of essential services was challenged by temporary shortages of health care workers and disruptions in the supply chain (28,29). These shortages were caused by large-scale quarantine of HCW's when a patient was found positive of COVID-19, but did not lead to deaths among HCW's as was the case during the Ebola outbreak. The provision of services was constrained in LHMC, but not to the same extend as during the Ebola outbreak.

Box 2: Covid-19 strategy

LHMC

A designated team was appointed to design and implement appropriate measures for the COVID-19 pandemic. Guided by protocols from the World Health Organization (WHO) and instructions from the district health authorities, the outbreak team drafted a matrix with different scales of measures for different scenarios ranging from few suspected cases to an overflow of COVID-19 suspects. Central elements in the plan were a strict separation between COVID-19 suspects and regular patients from the triage point at the entry point (picture 1), scale-up of infection prevention and control measures to prevent nosocomial spread and maintaining capacity for regular care in each scenario. A separate ward was cleared for the isolation of COVID-19 suspected patients awaiting their test result. Additional staff was recruited to secure the isolation ward, direct patients to follow the instructions of HCW's and carry out additional disinfection of contaminated areas. During the implementation of these measures HCW's were trained and educated in the proper use of personal protective equipment (PPE) and the spread, presentation and diagnosis of COVID-19.

Community

In close collaboration with community stakeholders LHMC designed a program to sensitize the community on COVID-19 since the amount of circulating incorrect information was quite alarming. With assistance of the local radio station, tunes were created with lyrics about COVID-19 and health messages in various local languages. Since gatherings were prohibited, these tunes were broadcasted by the local radio station and mobile public announcements system.

Teachers, who were at home due to closure of schools, were invited to participate in a cascade training on COVID-19. They were provided with instruction material and trained by HCW's to sensitise households on community level.

Confirmed COVID-19 patients

Once confirmed positive, COVID-19 patients were transported to regional treatment centres by the national ambulance service, coordinated by the health authorities (30). At strategic locations throughout the countries designated health facilities were established as treatment centres. As in many LMIC, Sierra Leone lacked a reliable supply of oxygen, mechanical ventilators and HCW's capable to deliver this treatment modality. With these and other common challenges of a LMIC, the treatments centres were ran with what was available (31).

Picture 1: screening station at the hospital entrance at LHMC

3. Problem statement and justification

The pandemic has pressured governments to divert resources to the COVID-19 response and potentially compromising other non-COVID-19 related essential health care services (32). In Sierra Leone concerns were raised that the unintended effects of the COVID-19 containment measures would outweigh the morbidity and mortality caused by the SARS-CoV-2 virus (33). In order to minimize the compromise of essential health care services, a rational approach was suggested to ensure access to these services in LMIC's (32). A modelling study across 118 LMIC's predicted that the COVID-19 outbreak could indirectly cause an additional 44.6% child and 38.6% maternal deaths in a scenario that resembled the situation in Sierra Leone, including strict movement restrictions, stay-at-home orders, lack of trust in the official health system and fear in the community of nosocomial infections (22). Following these widespread concerns regarding the effects of the pandemic on essential health care services, several studies reported on these services being compromised (34–38).

3.1 Maternal health

Early in the COVID-19 pandemic two main trends for Maternal and Newborn health services in LMIC's were reported: a declining use of services and a rapid detoriation of quality (34). The main contributing factors described included fear and limited access due to loss of income and unavailability of ambulances. Within facilities capacity was reduced due to physical distancing and quality impaired by inadequate supplies to follow IPC procedures (34). Another complicating factor was the lack of updated guidelines in LMIC's on how to handle a maternity case with signs and symptoms of COVID-19 (35). Specific concerns were raised on the increased interval between antenatal care (ANC) consultations since some African countries have adopted an interval of 3 months in the COVID-19 pandemic. As many women attend ANC services late, they may only visit a clinic once during their pregnancy. It is likely that the implications for maternal and child health are significant (39).
A study previously conducted at LHMC showed that the burden of malaria, malnutrition and anaemia during pregnancy is alarmingly high (40). A reduction of ANC visits would reduce opportunities for treatment and prevention and potentially lead to increase in morbidity and mortality. The first observations at the beginning of the pandemic included a steep decline in uptake of all maternal health services (38).

3.1 Child health

The direct effects of COVID-19 on children seem to be limited, since children mainly have a mild or asymptomatic disease course (41). However, there are concerns that children in LMIC's are more at risk due to a high prevalence of comorbidities such as exposure to air pollution, malnutrition and the relative high burden of acute respiratory tract infections (ARI) (41).
A significant challenge in the under-five population is the overlap between symptoms of COVID-19 and other common illnesses such as an ARI and malaria, both highly prevalent in Sierra Leone and many other LMIC's (42). As indicated earlier, both ARI and malaria are the main causes for mortality in the under-five population (6). Based on clinical presentation, it is impossible to distinguish COVID-19 from malaria or a regular ARI. While rapid diagnostic tests for malaria are widely available, available diagnostic options for COVID-19 are limited since it requires advance logistic and laboratory capacity (41).
A case series of paediatric COVID-19 cases found through contact tracing in Sierra Leone, reported a mild disease course with fever as the main presenting symptom. Additionally, 4 out of 9 children were co-infected with malaria (42). This example also illustrates that malaria co-infection with for malaria may be common and further complicates diagnosis. The authors of this case series state that it is unclear how

best to approach the large number of children with fever during the COVID-19 pandemic and suggest that an age specific case definition would be helpful for malaria-endemic areas (42). In the main paediatric hospital in Sierra Leone a drop op 75% in occupancy rate was observed during the lockdown (9). Parents refused to go to the hospital when their child had fever, a symptom of both COVID-19 and malaria, out of fear to be quarantined (43).

3.3 Infectious diseases

In the past decades, substantial progress has been made to reduce the disease burden of malaria in Africa. The COVID-19 pandemic poses significant threats to the established malaria control programs as happened during the Ebola outbreak (44,45). Routine preventive methods such as distribution of nets, indoor residual spraying or seasonal chemoprofylaxis are important elements of the control programs. When these preventive activities are disrupted and additionally people with malaria have limited access to treatment, an increase in morbidity and mortality is likely to occur (46). Estimates include a doubled number of deaths due to malaria (44).

Other established programs, for example for TB and HIV, also rely on continuous preventive activities, case finding and treatment. These and similar programs a threatened in the same manner by the COVID-19 pandemic (47,48). In Sierra Leone, a rapid decline in presumptive and confirmed TB cases was reported just after the lockdown. Since the symptoms of tuberculosis and COVID-19 may overlap, people possibly fear the stigma of being diagnosed with COVID-19 and avoid the health care system. Other people were not able to afford travelling to the health centre due a loss of income due to the lockdown (36). Another contributing factor is the diversion of resources towards COVID-19 related care away from TB (48).

3.4 Justification

As summarized above, the COVID-19 pandemic has created significant challenges to ensure coverage of health care services, both on the provision and utilization of health care services. The indirect effects on maternal health, child health, malaria programs and people living with HIV and/or TB in LMIC's is predicted to be substantial (22,44,47,48). At the beginning of the pandemic, the first reports in Sierra Leone already indicated a decline in utilization of health services (9,36,38). However, it remains unclear what the full extend of the impact of the pandemic is on utilization of hospital services. Not only during the lockdown period, but also afterwards. Evaluating the utilization of health services could serve as a starting point to estimate the indirect effects, since it might be challenging to measure indirect morbidity and mortality in Sierra Leone. During the Ebola outbreak, vulnerable groups were disproportionally affected (3). It also unknown whether these groups as similarly affected during the COVID-19 pandemic.

This thesis therefore aims to analyse what the effects on the utilization of hospital services were during and after the lockdown period in the LHMC and how utilization was affected in different patient groups. Additionally, a literature review will be performed to further understand health-seeking behaviour during the COVID-19 pandemic.

A combination of the findings of the LHMC case study with the literature review, would provide additional information on why utilization of hospital services was affected and which groups were affected most. This would provide an insight in health care seeking behaviour during the COVID-19 pandemic and could aide and inform policymakers and stakeholders to evaluate the measures taken and to balance future measures in the remaining of the present pandemic or in a next pandemic. Additionally, the findings could aide policymakers to tailor measures to protect vulnerable groups.

4. Study questions

The following research questions are formulated:

1. What is the difference in utilization of LHMC hospital services during the Covid-19 lockdown (LD) period (April-June 2020) and post-lockdown (Post-LD) period (July-December 2020) compared to corresponding months in 2019?
    a. What are the differences in the utilization of hospital services in the LD and Post-LD periods between services related to maternal health, child health, HIV and/or TB and non-communicable diseases (NCD's)?
    b. What are the differences in utilization of hospital services in LD and Post-LD periods between services related to acute and non-acute conditions?
    c. What are the differences in utilization of hospital services in LD and Post-LD periods between male and female patients?

2. What is described in the current literature on the influence of an outbreak or pandemic on the determinants of health seeking behaviour Sierra Leone or similar other countries in West Africa?

3. Which recommendations can be given to policymakers in Sierra Leone on appropriate measures during an outbreak or pandemic, based on the findings of study question 1 and 2?

5. Objectives

This thesis aims to analyse the utilization of regular hospital services during the COVID-19 LD (April-June 2020) and Post-LD periods (July-December 2020) in the LHMC in Sierra Leone. The differences between hospital services for specific patient groups (maternal health, child health, infectious diseases and NCD's), acute and non-acute care and gender will be analysed.
Furthermore, this thesis aims to give an overview of the literature what the effect of a pandemic or outbreak in on health seeking behaviour in Sierra Leone or other similar West African countries.
At last, based on the findings of the described objective, the aim of this thesis is to give recommendations on appropriate measures during an outbreak or pandemic considering vulnerable groups.

6. Methods

This chapter is divided in three main subchapters. First, subchapter 6.1 describes the methods used for the quantitative analysis of LHMC hospital date. Second, subchapter 6.2 describes methods for the literature review and the selection of the analytical framework.

6.1 Quantitative analysis LHMC hospital data

6.1.1 Study design

The design for this study is a retrospective secondary analysis of hospital data. The monthly hospital statistics were provided by LHMC covering the complete years 2019 and 2020. This time frame was chosen to cover the start of the COVID-19 pandemic with extensive lockdown periods and to cover a period without a lockdown or other major events. The year 2019 was selected to serve as a point of reference, since this was a relatively stable year with no major internal changes (hospital policies, capacity of offered services) or external changes.
During the period before 2019, several major changes were identified and therefore not included in the analysis. In 2018 LHMC expanded its hospital services with a maternal health referral and outreach program. In 2017 an additional ward for isolated and chronic wound cases was opened. During the outbreak of Ebola in 2014 and 2015, hospital utilization was affected substantially (27).

6.1.2 Indicators for hospital utilization

Within the four patient groups utilizing services related to maternal health, child health, HIV and/or TB and NCD's, indicators were selected representing hospital utilization, for example number of deliveries, outpatient under five cases etc. Relevant indicators who were not specific for a patient group were described in a general group.
The indicators were divided in acute versus non-acute and when possible indicators were separated between gender. Gender disaggregation was available for the indicators: outpatient department (OPD) visits for the general population and under five years of age (<5), and the number of surgical procedures. Table 1 shows the 14 selected indicators.
In order to give an indication of the number of COVID-19 suspected patients visiting the LHMC during the study period, the number of reported ARI cases among adolescents and adults (>15 years) were also included. Reliable data on indicators more directly related to COVID-19, were not available.

	General	Maternal health	Child Health	HIV and/or TB	NCD's
Acute care	Admissions	Deliveries Admissions	<5 admissions <5 blood transfusions	-	-
Non-acute care	OPD visits - male - female (>15 ARI cases)	ANC visits	OPD <5 cases - male - female OPD <5 ARI cases OPD <5 malaria cases	OPD visits TB and/or HIV TB screening	OPD visits NCD
Both	Surgeries - male - female	-	-	-	-

Table 1: Overview of hospital indicators for hospital utilization in the different patient groups, divided between acute and non-acute care.

6.1.3 Definition of LD and Post-LD periods and reference periods

The official lockdown started on April 5 and ended on June 24 2020 with varying degrees of restrictive measures. In general, movement between different districts was prohibited and during several three-day periods people were confined to their houses.
For this study, the period covering April, May and June was selected as the LD period. The remaining months of 2020 (July, August, September, November, December) were selected as the Post-LD period. For each indicator the average monthly number in the LD and Post-LD was calculated. The corresponding months in 2019 were selected as a reference to take into account possible seasonal influences of malaria incidence and the rainy season.

6.1.4 Data analysis

The data was analysed in three steps. First the data was visualized in graphs using Microsoft Excel to view the course of the indicators over the entire study period ranging from 2019 to 2020.

In second instance, Microsoft Excel was used to calculate the average monthly values for all indicators during the LD and Post-LD periods in 2020 and corresponding reference periods in 2019. The difference between the LD or Post-LD periods and their reference value was expressed as a percentage. A negative value corresponded with a reduction; a positive value corresponded with an increase relative to the reference value in 2019.

To add statistical validity to the basis calculations, a third step of data analysis was added with the interrupted time series analysis (ITSA) (49). This is an accepted and commonly used statistical method to analyse effects of an intervention when it is not possible to compare the intervention with a control group (50).
For the purpose of this analysis, data was imported in STATA. Subsequently, the study period was divided in three periods separated by two interventions, the start and the end of the lockdown period, also visualized in figure 3.

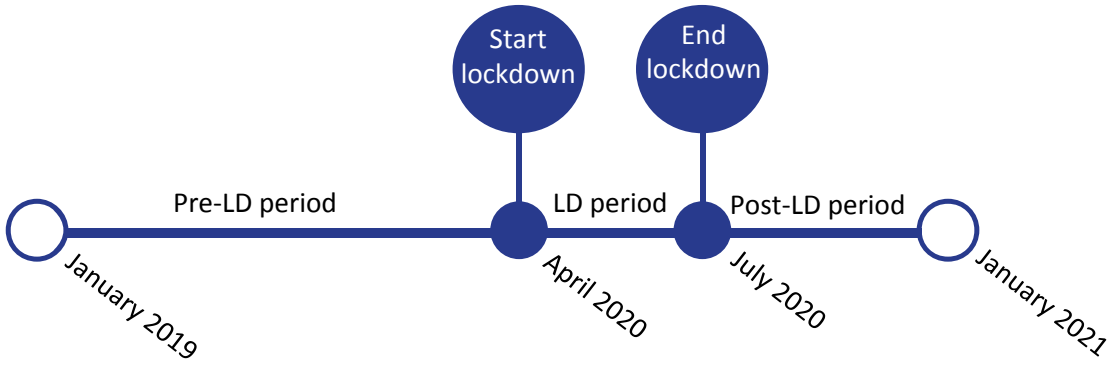


Figure 2: Timeline for ITSA analysis. Two interventions, the start and the end of the lockdown separate the study period in 3 periods Pre-LD, LD and Post-LD.

The ITSA estimates the effect of an intervention using a regression-based approach. Based on the measurements at equally spaced time-points, the ITSA method calculates a linear trend line before and after an intervention. The differences in characteristics between the trend lines (intercept, slope, level change, and change in slope) are used to describe the effect of an intervention (49).

A clear directive for the number of data points in each period is not given, but ideally multiple data points before and after the interventions are available. In other studies using ITSA, the number of data points ranged from 12-32 before and after the intervention (51). A minimum of 3 data points is required to run the analysis in STATA. De dataset of this study contains a total of 24 data points, 15 before the start of the lockdown, 3 during the lockdown and 6 after the lockdown.

For the indicators related to malaria with strong seasonal fluctuations, the ITSA would not give an adequate representation. In order to correct for seasonal fluctuation, data from multiple years is required to establish a correction model. Since this data is not available, the ITSA will not be conducted on the indicators that are highly influenced by the malaria incidence during rainy season. These include all indicators for child health and diagnosis of malaria.

6.1.5 Ethical considerations

Permission to use the hospital statistics for the purpose of this thesis was obtained from the Lion Heart Medical Centre. The KIT Research Ethics Committee (REC) granted a waiver for full ethical review under project code S-141. The rationale for this decision was the use of anonymized hospital statistics.

6.2 Literature review and analytical framework

6.2.1 Literature review

Relevant literature was searched using the databases PubMed and Google Scholar using a combination of the following words: COVID-19, Corona, Coronavirus, pandemic, outbreak, Ebola, health behaviour, health seeking behaviour, risk perception, knowledge, Sierra Leone, West Africa, Guinee, Libera and LMIC. Additional articles were found through reference searching. Articles were considered when they addressed research question 2 and focused on health behaviour in general, not health behaviour specific for COVID-19. Articles from outside the West African region were considered when relevant to the setting in Sierra Leone.

6.2.2 Analytical framework: the Health Believe Model

The focus of this thesis lies on utilization of health care services during the lockdown period of the COVID-19 pandemic in Sierra Leone and to understand how health behaviour was influenced. We therefore aimed to find a model that gives guidance on the different factors that determine health behaviour. The Health Believe Model (HBM) was selected to serve as a conceptual framework to describe how health behaviour was influenced during the COVID-19 pandemic and led to changes in utilization of health care services. The HBM was initially developed in the 1950's to enhance the effectiveness of health education programmes. It was acknowledged that demographic variables such as socioeconomic status, gender and age were associated with preventive health measures and health behaviour in general. The likelihood of experiencing a health problem and its perceived severity in combinations with the expected benefits and barriers, were seen as the key beliefs that determine health behaviour. It was shown that these beliefs were associated with health behaviour and can be used to distinguish between people who did and did not engage in certain health behaviour (52,53)

6.2.2.1 Description of the HBM

The HBM is a conceptual framework based on 6 determinants health behaviour:

1. Perceived susceptibility
2. Perceived severity
3. Perceived benefits
4. Perceived barriers
5. Cues to action

The perception of threats includes beliefs on perceived susceptibility and perceived severity of a disease. The evaluation of behaviour includes beliefs on the perceived benefits and barriers of certain behaviour and what the expected outcome is (52). An individual would consider for example: 'What is my risk to get malaria and would it make very ill?' (perception of threats) and 'Which healthcare service am I likely to receive at my nearest health centre?' and 'What are my risks and what hinders me to go there? (outcome expectation). In addition to these key aspects, the HBM describes that certain cues can trigger health behaviour. These cues include: experiencing certain symptoms, social influence or health campaigns. For example, in the case of malaria: an individual experiences fever, a neighbour shares experiences of their illness or a health message on malaria is broadcasted on the radio. These and similar cues can motivate a person to seek healthcare. The model is shown in figure 5.

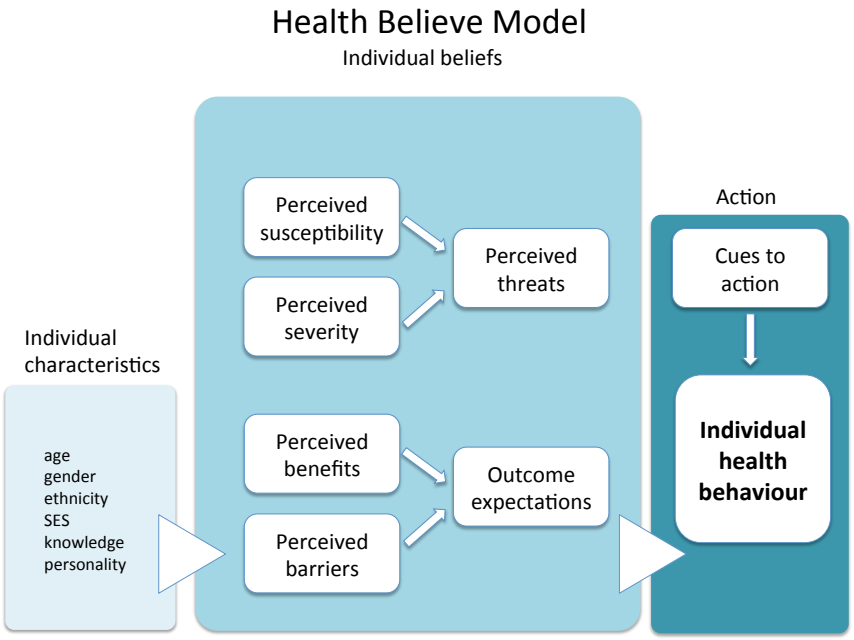


Figure 3: The Health Believe Model (HBM), a conceptual framework for individual health behaviour

The basic concept of the HBM has been applied in numerous research projects on predicting preventive health behaviour and usage of health care services and adherence to health care advice (54). To date, the HBM is one of the most commonly used frameworks to understand individual health behaviour.

6.2.2.2 Limitations of the model

The conceptual framework of the HBM is a simplified version of the complex process of individual deliberation that determines health behaviour. The model does not take into account the non-health related reasons for health behaviour such as peer pressure, social acceptability, norms or habits. Furthermore, the model does not explicitly evaluate access or availability of services, which is relevant in the context of a pandemic in a LMIC. In order to mitigate these limitations and achieve an optimal fit, the model is interpreted in its most broad sense. Perceived barriers and benefits are not strictly related to health, but may also include for example the expectation that health care services are poor in quality because all resources have been reverted to COVID-19 or the scale up of triage protocols and associated waiting time. Furthermore, cues are described as a trigger for health care behaviour. In the context of a pandemic it is appropriate to also consider cues that hinder certain health behaviour. During the COVID-19 pandemic for example it is possible that people would not seek health care when experiencing COVID-19 related symptoms out of fear for stigmatization and isolation.

6.2.2.3 Applying the HBM model in the literature review

The studies found by the literature search will be discussed in structured manner and organized following the 6 determinants of the HBM. The findings will be used to hypothesize how the evaluation of health behaviour may have been influenced by the COVID-19 pandemic and led to altered health behaviour and subsequently a different utilization of health care services.

7. Results quantitative analysis

The results of the quantitative analysis will be presented in this section discussed according to the different patient groups utilizing healthcare and their indicators, subdivided into general services, maternal health, child health, HIV and/or TB and NCD's and characterized as acute or non-acute health service (table 1).

7.1 General hospital services

7.1.1 OPD visits

Graph 1A visualizes the number of monthly OPD consultations, an indicator for non-acute hospital care. In the period before the LD, the average number of OPD visits fluctuated around 600 with a reduction to 150 (-76%) monthly visits during the lockdown (table 2). After the lockdown the number of monthly visits quickly restored to the same level as before the lockdown. When the indicator is disaggregated by gender, only minor differences are observed between male and female patients.
The ITSA analysis (graph 1B) shows a significantly change of a reduction of 337 predicted OPD visits ($p<0.000$) during the LD period. In the post-LD period the predicted OPD visits increase with 281 ($p<0.000$). Additionally, the trend line in the post-LD period is strongly positive with an average increase of 40 OPD visit each month ($p<0.000$).
As indicated before, the number of adolescent and adult patients with an ARI was included to provide contextual information on the number of patients reporting with COVID-19 or diseases with a similar clinical presentation. As shown in table 2, during the LD and post-LD periods this number was reduced with 91 and 70% respectively.

7.1.2 Admissions

The indicator hospital admission resembles acute care, since patients are admitted when their condition requires hospital treatment and cannot be postponed. Graph 2A visualizes the course of admissions during the entire study period. During the LD period, the number of admissions reduced with 53% (table 2). In the post-LD period, the number of monthly admissions increased, with an unexpected spike in November towards the normal level (Graph 2A). Nevertheless, the average number of admissions in the post-LD period is still reduced with 34% compared to the reference period.
In the ITSA, similar trends are observed and shown in graph 2B. After de start of the lockdown, the level of the trend line decreases with 127 admissions ($p <0.001$). After the end of the lockdown the level of the trend line does not change significantly (16, $p = 0.435$), but the slope is strongly positive with an average increase of 23 admissions each month ($p = 0.003$). This resembles an upward trend of monthly hospital admissions.

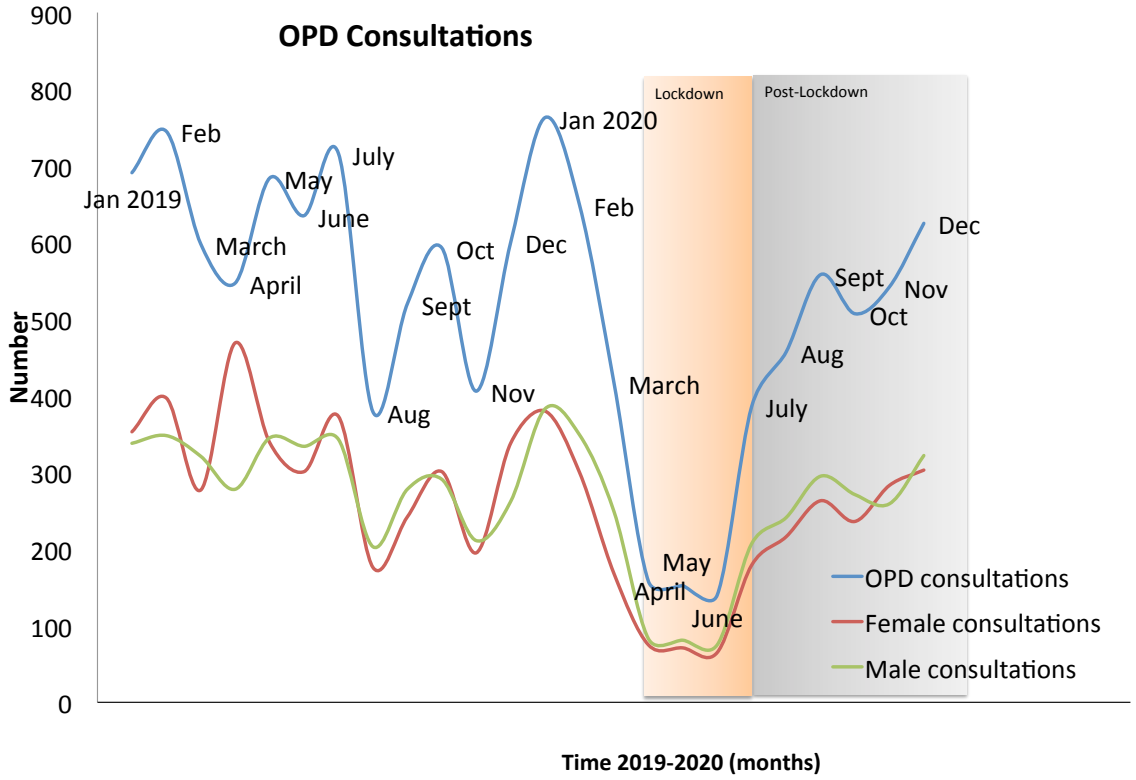
7.1.3 Surgical procedures

The indicator surgical procedures, contains both elements of acute and non-acute care. Before the lockdown, the number of monthly surgeries fluctuates around 60 as shown in graph 3A. During the LD period the average monthly number of surgeries decreases to 21, a reduction of 64% (table 2). In the post-LD period this increased to 49, but still 21% below the average of the reference period. The number of surgeries was further subdivided according to gender, similar changers were observed between male and female patients during the LD and post-LD period (table 2)

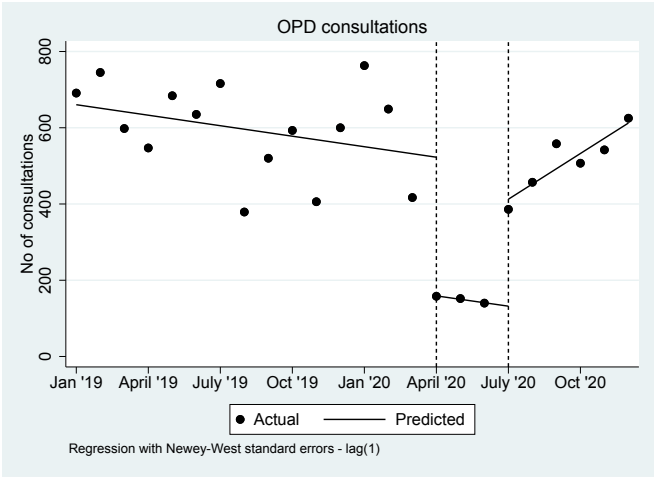
In the ITSA analysis a similar pattern was observed comparable to hospital admissions (graph 3B). After de start of de lockdown, the level of the trend line decreased with 45 monthly surgeries (<0.001) and after the end of the lockdown, a trend line had a positive slope of an average increase of 9 surgeries each month (<0.001).

Indicators of utilization of hospital services during lockdown and post-lockdown periods						
	Lockdown			Post-Lockdown		
Indicator	2020 LD (A/M/J) (monthly average)	2019 reference (A/M/J) (monthly average)	Difference (%)	2020 post LD (July-Dec) (monthly	2019 reference (July-Dec) (monthly average)	Difference (%)
1 - General						
Total visits outpatient clinic	150	622	-76%	513	536	-4%
Male visits outpatient clinic	80	319	-75%	266	265	0%
Female visits outpatient clinic	70	370	-81%	247	221	12%
ARI cases >15yrs outpatient clinic	2	25	-91%	7	24	-70%
Admissions	97	208	-53%	180	271	-34%
Total surgical procedures	21	59	-64%	49	62	-21%
Male surgical procedures	12	33	-64%	29	35	-17%
Female surgical procedures	9	27	-67%	20	27	-26%
2 - Maternal health indicators						
Visits antenatal clinic	55	176	-69%	150	155	-3%
Deliveries	12	35	-66%	36	39	-8%
Admissions	20	47	-57%	55	60	-8%
3 - Child health (under-five) indicators						
Total <5 outpatient visits	51	145	-65%	87	114	-24%
Male <5 outpatient visits	25	83	-70%	47	59	-20%
Female <5 outpatient visits	26	62	-58%	39	58	-33%
Outpatient treatment for <5 ARI case	5	15	-67%	12	25	-52%
Outpatient treatement for <5 malaria case	7	58	-88%	18	39	-54%
<5 admission	48	90	-47%	47	63	-25%
<5 blood transfusion	16	24	-33%	25	25	0%
4 - Infectious disease indicators						
TB microscopy screening	0	32	-100%	21	24	-13%
Outpatient visits for TB and/or HIV	2	12	-83%	10	13	-23%
5 - Non-communicable disease indicators						
Outpatient visits voor NCD's	15	85	-82%	49	77	-36%

Table 2: indicators of utilization of hospital services, during LD and post LD periods.

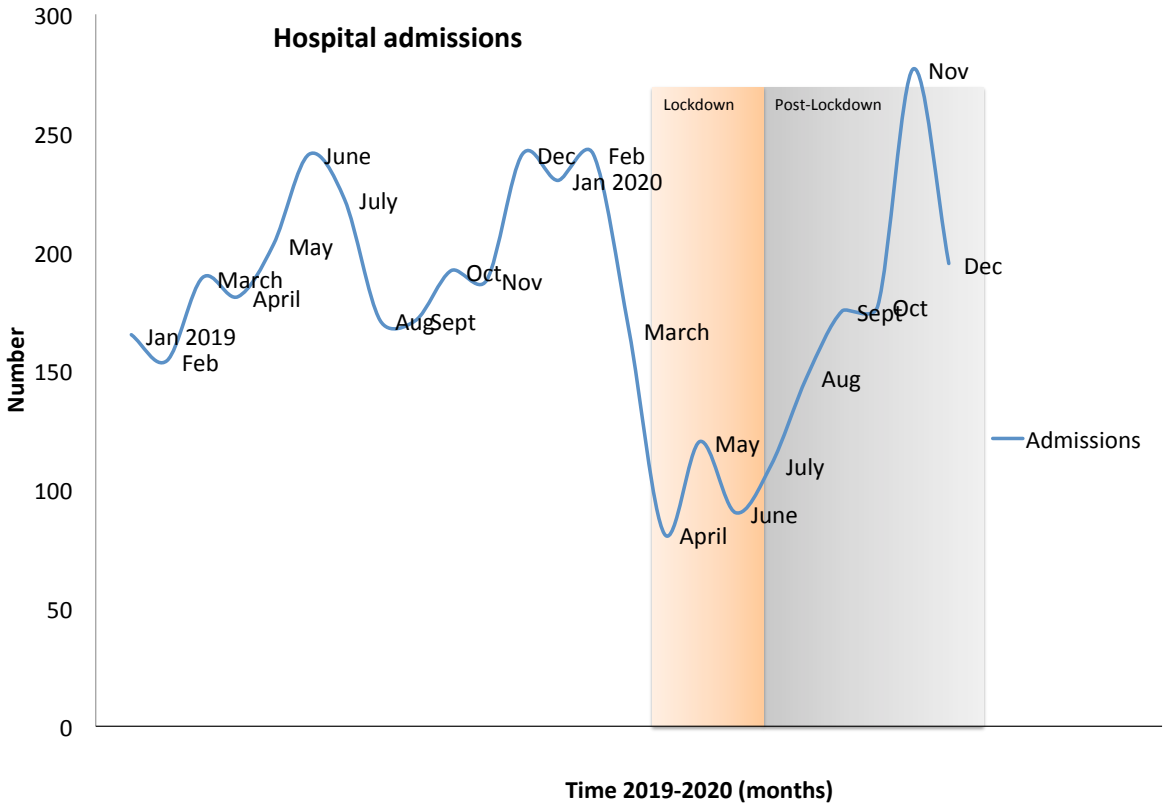


Graph 1A: Number of monthly OPD consultations during 2019 and 2020. The lockdown period is indicated in orange and post-lockdown period in grey. Total numbers (blue) divided in male (green) and female (red) patients.

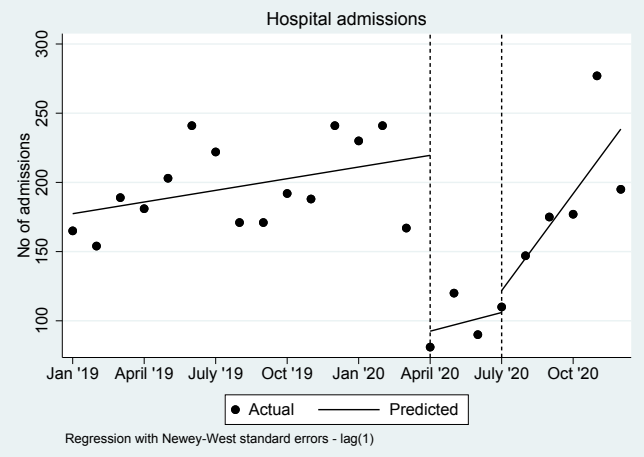


	Value	p-value
Pre-lockdown		
Intercept	660.48	<0.000
Slope	- 9.18	0.237
Lockdown		
Level change	- 336.74	<0.000
Slope	- 9.00	<0.000
Slope LD-PreLD	- 0.18	0.981
Post-lockdown		
Level change	280.57	<0.000
Slope	39.97	<0.000
Slope PostLD-LD	48.97	<0.000

Graph 1B: result of the ITSA analysis of the monthly OPD visits with the calculated trend lines during the Pre-lockdown, Lockdown and Post-lockdown periods.

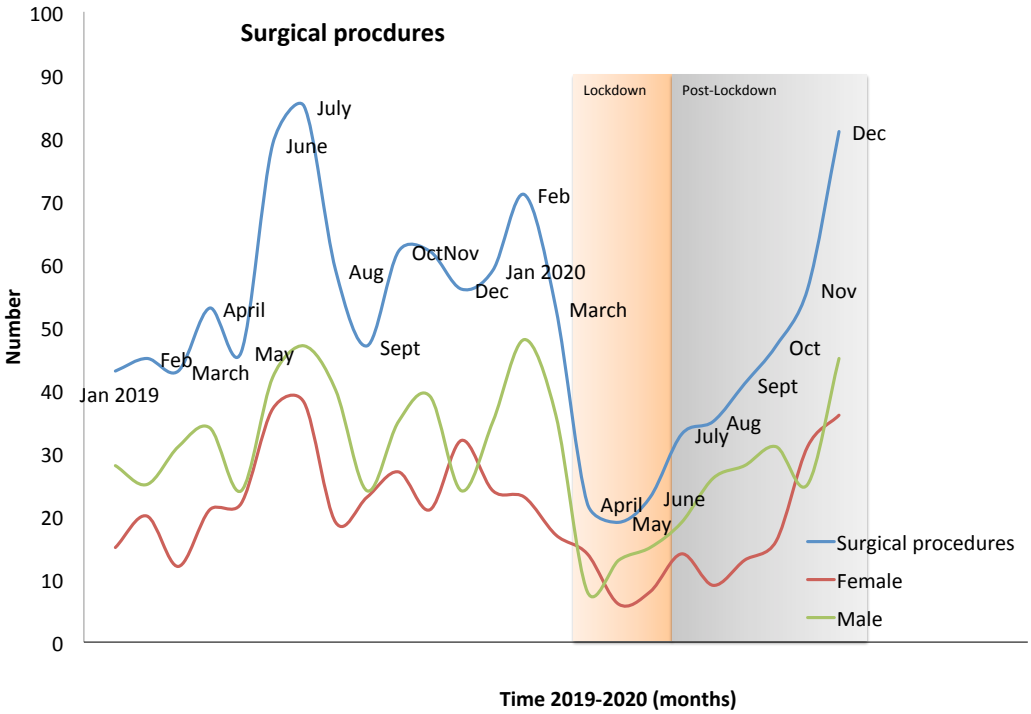


Graph 2A: Number of monthly hospital admissions during 2019 and 2020. The lockdown period is indicated in orange and post-lockdown period in grey.

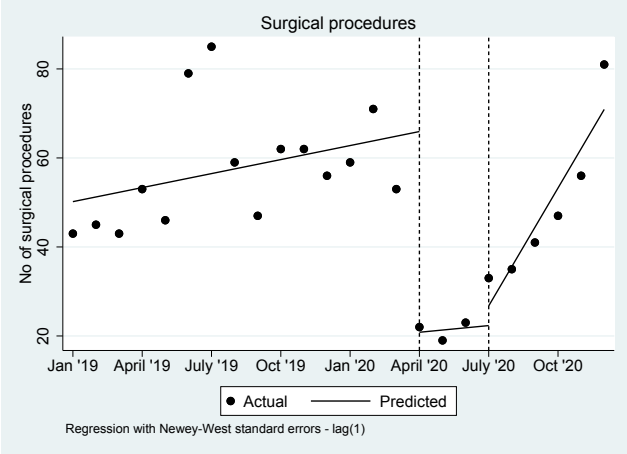


	Value	p-value
Pre-lockdown		
Intercept	166.39	<0.001
Slope	2.81	0.149
Lockdown		
Level change	-127.05	<0.001
Slope	4.50	0.638
Slope LD-PreLD	1.68	0.868
Post-lockdown		
Level change	15.80	0.435
Slope	23.34	0.003
Slope PostLD-LD	18.84	0.138

Graph 2B: result of the ITSA analysis of the monthly hospital admissions with the calculated trend lines during the Pre-lockdown, Lockdown and Post-lockdown periods.



Graph 3A: Number of monthly surgical procedures during 2019 and 2020. The lockdown period is indicated in orange and post-lockdown period in grey. The blue line indicates the total number of surgeries, in red the female patients and in green the male patients.



	Value	p-value
Pre-lockdown		
Intercept	50.18	<0.001
Slope	1.05	0.084
Lockdown		
Level change	- 45.1	<0.001
Slope	0.50	0.606
Slope LD-PreLD	- 0.55	0.590
Post-lockdown		
Level change	4.43	0.296
Slope	8.83	<0.001
Slope PostLD-LD	8.33	0.001

Graph 3B: result of the ITSA analysis of the monthly surgical procedures with the calculated trend lines during the Pre-lockdown, Lockdown and Post-lockdown periods.

7.2 Maternal health

7.2.1 ANC consultations

During the LD period, the number of ANC consultations, an indicator of non-acute hospital services, reduced with 69% and restored to the normal level in the post-LD period (table 2 and graph 4A). In the ITSA (graph 4B), the number of monthly ANC consultations reduced with 97 ($p = 0.003$) and increased again after the LD with 108 ($p = 0.001$).

7.2.2 Maternity admissions and deliveries

For maternity admissions and deliveries, both indicators of acute care, a similar pattern is observed. During the LD-period a stark reduction is observed of 57% and 66% respectively for admissions and deliveries respectively. In the post-LD period the numbers restore to just below the reference (table 2). These findings are supported by the ITSA analysis of both indicators (graph 4C and D). For maternity admissions the analysis shows a decrease of 30 monthly admissions ($p = 0.003$) after the start of the LD. In the post-LD period an increase of 35 ($p = 0.001$) admissions is predicted. Additionally the slope of the trend line in the post-LD period is positive with an increase of 5 admissions each month. For deliveries a similar pattern is observed (graph 4D).

7.3 Child health

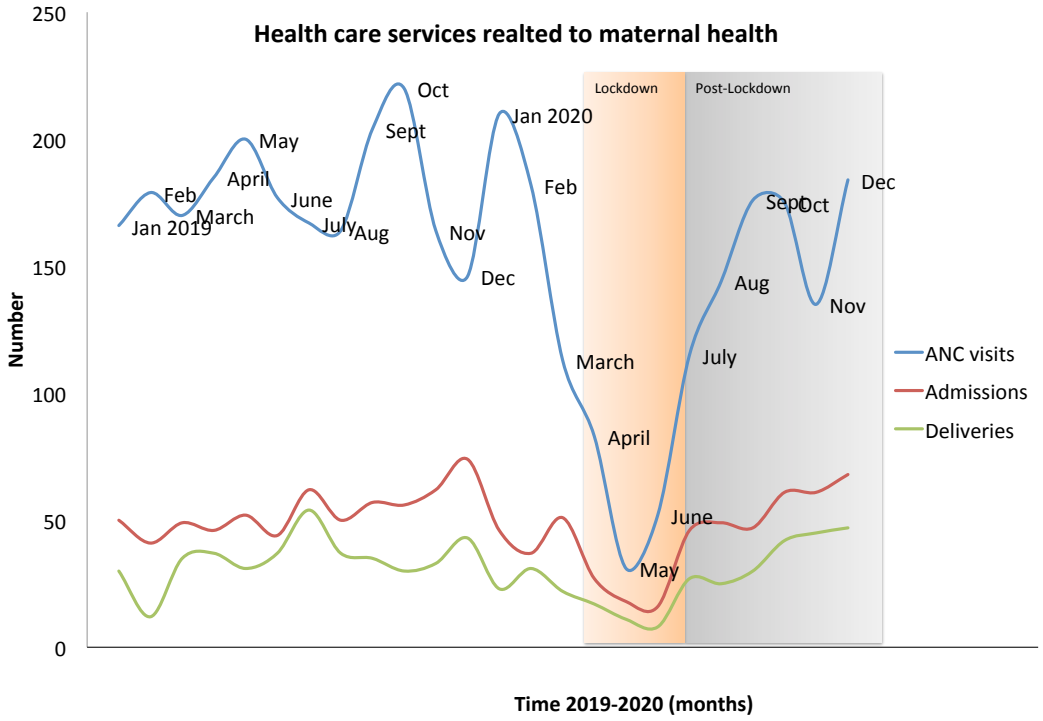
7.3.1 Under-five OPD consultation and diagnosed ARI and malaria patients

Graph 5A shows the course of under-five OPD consultations during the study period. During the rainy season in 2019 (March until September) a peak in consultations was seen, supporting the previous statement of seasonal influence. For diagnosed under-five malaria cases this peak is even more profound, shown in graph 5B. The rainy season in 2020 coincides with the LD period, where drop in OPD consultations, malaria and ARI cases is observed instead of the expected peak due to a rise in malaria incidence during the rainy season. When the monthly OPD consultations during the LD are compared with the reference period, a reduction of 65% is observed (table 2). When specifically looking at diagnosed under-five malaria and ARI cases, a reduction of 88 and 67% respectively is observed during the lockdown. In the post-LD period, the number of monthly under-five OPD consultations increases again, but the average remains 25% below the reference period. The number of under-five malaria and ARI cases increased slightly in the post-LD period, but remained substantially below, 54 en 52% below the reference level.
In the gender disaggregation of under-five OPD cases, the reduction of visits during the LD is more profound among boys than girls, respectively a reduction of 70% versus 58%. In the post-LD period the reduction is slightly more profound among girls than boys, respectively a reduction of 33% versus 20% (table 2).

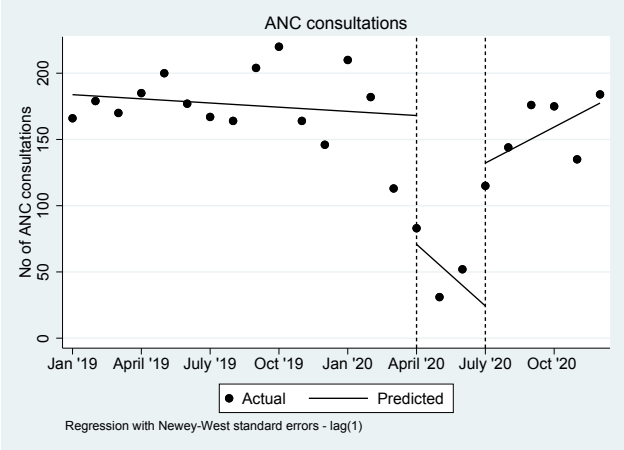
7.3.2 Under-five admissions and blood transfusions

Graph 5C shows the course of the monthly number of under-five admission and blood transfusions. Mainly the number of under-five admissions is highly fluctuant, with a clear peak in admissions during the rainy season in 2019. During 2020 a peak in under-five admissions is seen in February (before the

rainy season) and a small peak during the rainy season and LD period in May. The number of under-five blood transfusions shows a peak during the rainy season in 2019 and a slight increase after the LD period and rainy season in 2020.
When comparing the average under-five admissions with the reference period (table 2), a reduction of 47% is observed during the LD period. In the post-LD period, the number is reduced with 25%. For the number of under-five blood transfusions, a reduction of 33% during the LD is observed. In the post-LD period, the under-five blood transfusion is at a similar level as the reference period.

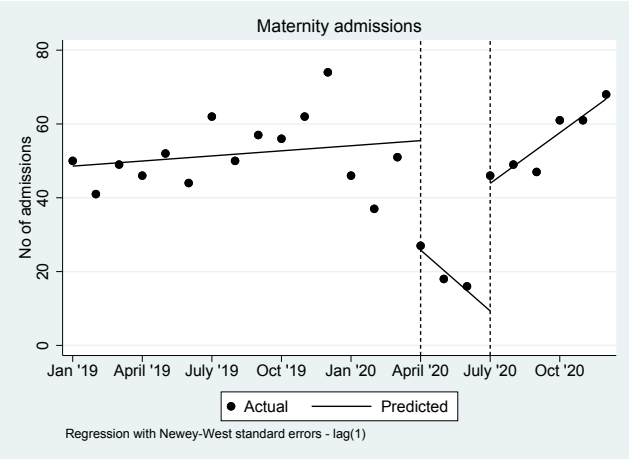


Graph 4A: Number of monthly maternal health services during 2019 and 2020. The lockdown period is indicated in orange and post-lockdown period in grey. The blue line indicates the ANC visits, the red line the admissions and the green line the deliveries.



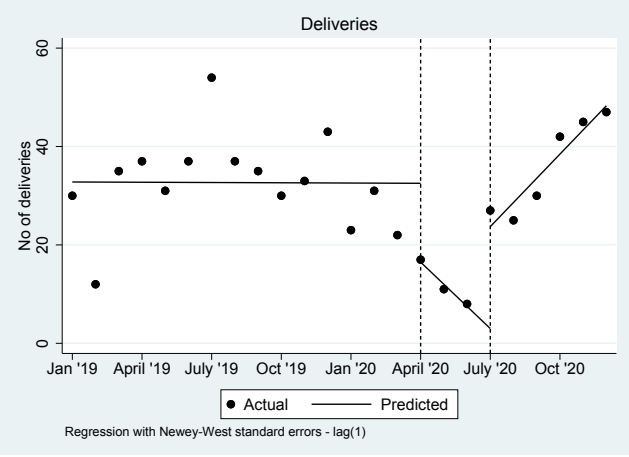
	Value	p-value
Pre-lockdown		
Intercept	183.82	<0.001
Slope	- 1.05	0.589
Lockdown		
Level change	- 97.23	0.003
Slope	-15.50	0.136
Slope LD-PreLD	- 14.45	0.147
Post-lockdown		
Level change	107.86	0.001
Slope	9.06	0.031
Slope PostLD-LD	24.56	0.021

Graph 4B: result of the ITSA analysis of the monthly ANC visits with the calculated trend lines during the Pre-lockdown, Lockdown and Post-lockdown periods.



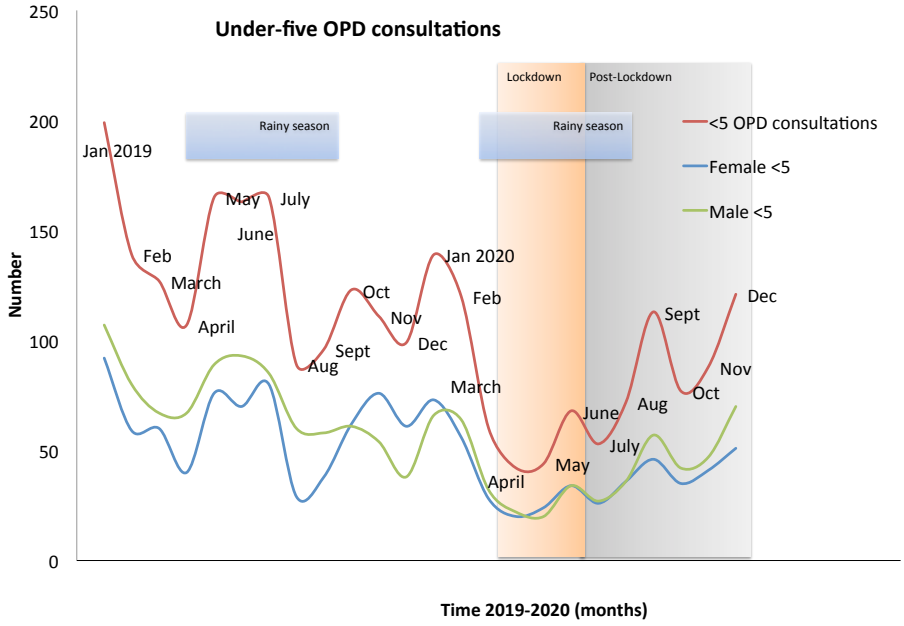
	Value	p-value
Pre-lockdown		
Intercept	48.56	<0.001
Slope	0.46	0.525
Lockdown		
Level change	- 29.65	0.002
Slope	- 5.50	<0.001
Slope LD-PreLD	- 5.96	<0.001
Post-lockdown		
Level change	34.57	<0.001
Slope	4.57	<0.001
Slope PostLD-LD	10.07	<0.001

Graph 4C: result of the ITSA analysis of the monthly maternity admissions with the calculated trend lines during the Pre-lockdown, Lockdown and Post-lockdown periods.

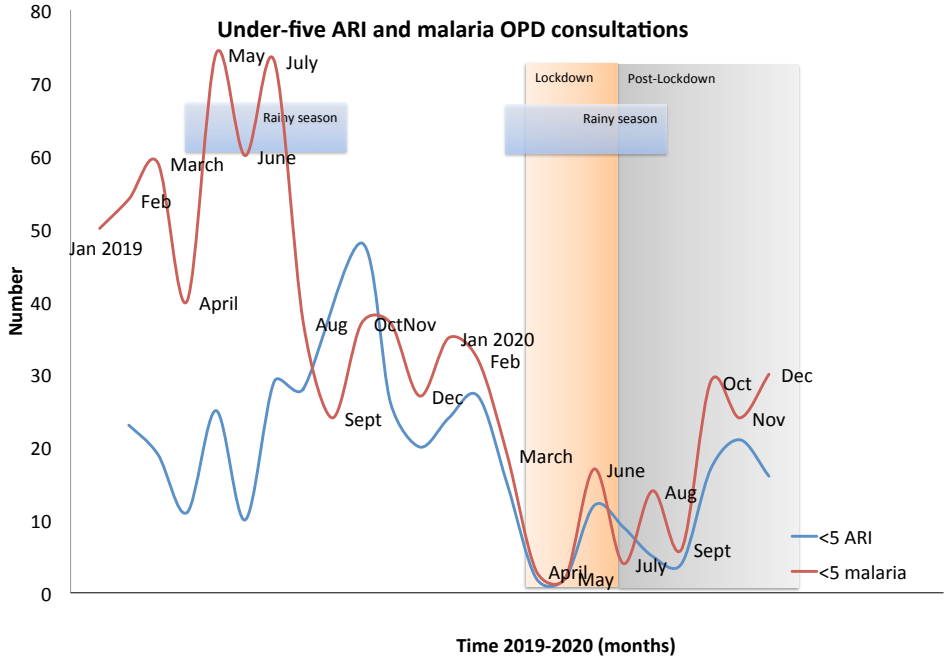


	Value	p-value
Pre-lockdown		
Intercept	32.79	<0.001
Slope	- 0.179	0.979
Lockdown		
Level change	- 16.02	0.008
Slope	- 4.50	<0.001
Slope LD-PreLD	- 4.48	<0.001
Post-lockdown		
Level change	20.71	<0.001
Slope	4.91	<0.001
Slope PostLD-LD	9.41	<0.001

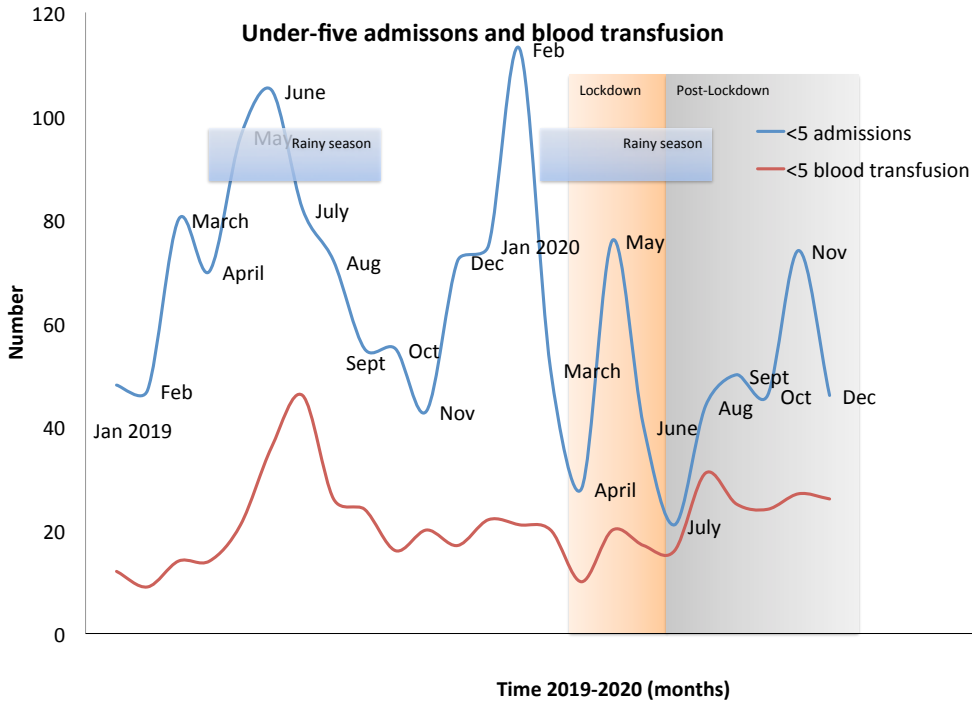
Graph 4D: result of the ITSA analysis of the monthly deliveries with the calculated trend lines during the Pre-lockdown, Lockdown and Post-lockdown periods.



Graph 5A: Under-five OPD consultations during 2019 and 2020. The rainy season is indicated with the blue bar, the lockdown period is indicated in orange and the post lockdown period in grey. In red the total number, in blue female and green male under-five patients.



Graph 5B: Under-five OPD consultations for patients diagnosed with an ARI (in blue) and malaria (in red). The rainy season is indicated with the blue bar, the lockdown period is indicated in orange and the post lockdown period in grey.



Graph 5C: Under-five admissions (blue) and blood transfusions (red). The rainy season is indicated with the blue bar, the lockdown period is indicated in orange and the post lockdown period in grey.

7.4 HIV and/or TB

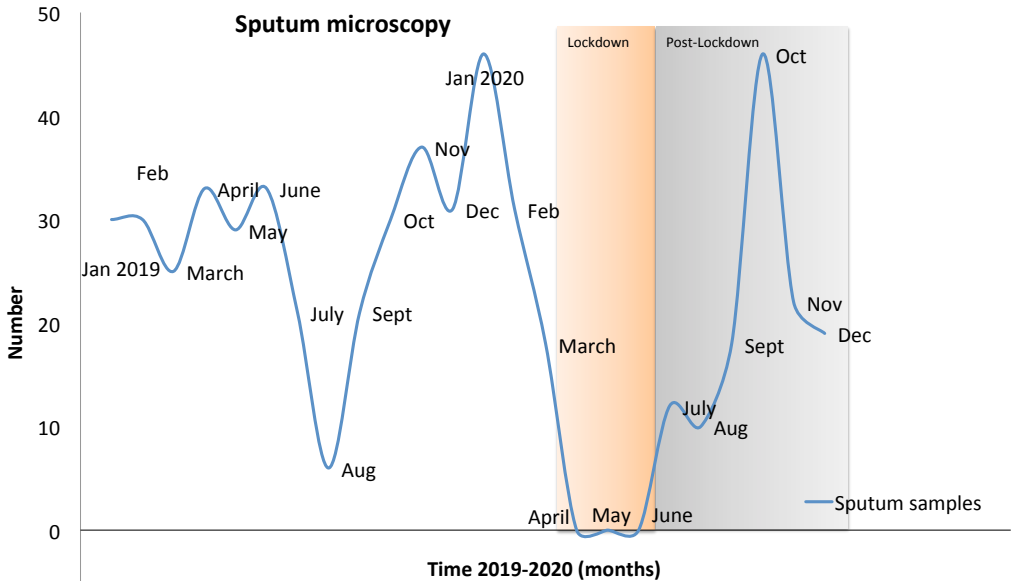
The indicators for HIV and/or TB include the number of sputum samples analysed to diagnose tuberculosis (TB) and the number of consultations for HIV and TB (both initial diagnosis and follow up). Both indicators are grouped under non-acute health care services.

7.4.1 Sputum microscopy

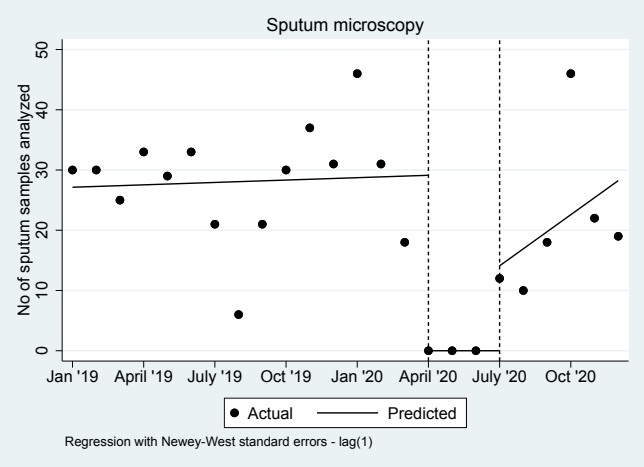
We observed the largest reduction, of 100%, in the number of sputum samples analysed to diagnose TB during the LD period (graph 6A, table 2). In the post-LD period the number of samples analysed increased to an average still 13% below the reference period. The ITSA analysis showed a reduction of 29 sputum samples ($p < 0.001$) after the start of the lockdown and an increase of 14 monthly-analysed sputum samples ($p = 0.014$) after the end of the lockdown (graph 6B).

7.4.2 OPD consultations for HIV and/or TB

Graph 7A visualized the course of OPD consultations for HIV and/or TB during the study period. The numbers fluctuate around 10 to 20 average each month, a relatively small proportion of total OPD visits (table 2). During the LD period the number of consultations for HIV and/or TB reduced with 83% and in the post-LD this number was reduced with 23% compared to the reference period.
In the ITSA analysis (graph 7B) a reduction of 16 ($p <0.001$) consultations for HIV and/or TB was predicted after the start of the lockdown and an increase of 9 visits ($p = 0.007$) after the end of the LD.

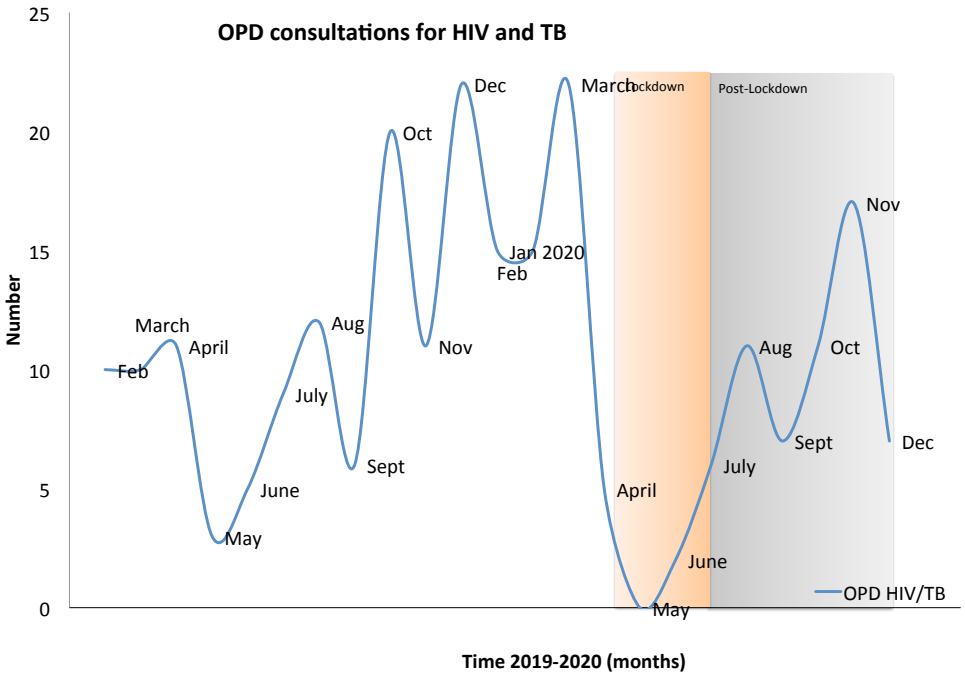


Graph 6A: Number of monthly analyzed sputum samples during 2019 and 2020. The lockdown period is indicated in orange and post-lockdown period in grey.

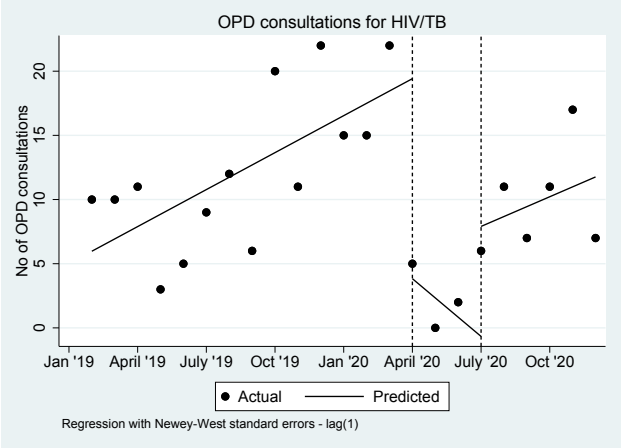


	Value	p-value
Pre-lockdown		
Intercept	27.14	<0.001
Slope	0.13	0.809
Lockdown		
Level change	-29.12	<0.001
Slope	0	1.00
Slope LD-PreLD	-0.13	0.809
Post-lockdown		
Level change	14.10	0.014
Slope	2.83	0.184
Slope PostLD-LD	2.83	0.184

Graph 6B: result of the ITSA analysis of the monthly analysed sputum samples with the calculated trend lines during the Pre-lockdown, Lockdown and Post-lockdown periods.



Graph 7A: Number of monthly OPD visits during 2019 and 2020. The lockdown period is indicated in orange and post-lockdown period in grey.

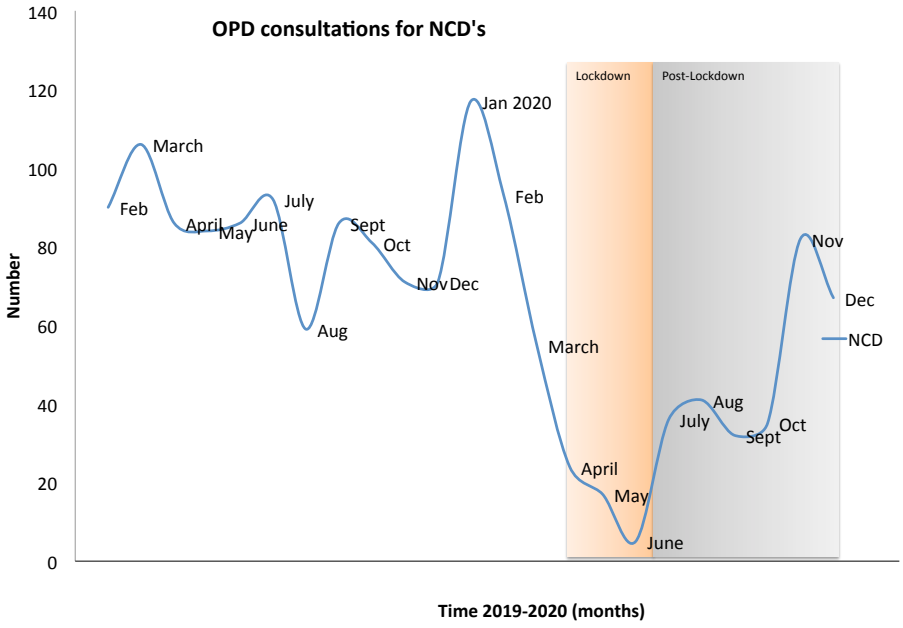


	Value	p-value
Pre-lockdown		
Intercept	5.97	0.036
Slope	0.96	0.004
Lockdown		
Level change	- 15.58	< 0.001
Slope	-1.50	0.136
Slope LD-PreLD	- 2.46	0.030
Post-lockdown		
Level change	8.57	0.007
Slope	0.77	0.332
Slope PostLD-LD	2.62	0.036

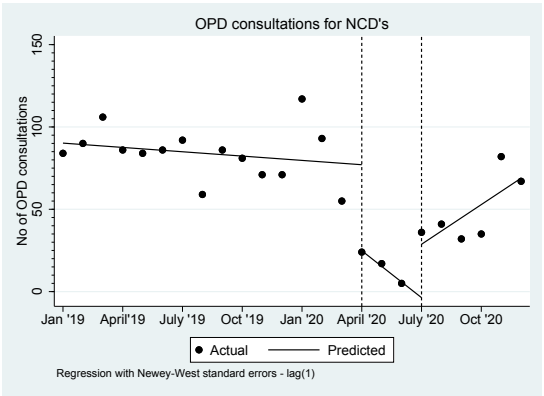
Graph 7B: result of the ITSA analysis of the monthly OPD visits for HIV and/or TB with the calculated trend lines during the Pre-lockdown, Lockdown and Post-lockdown periods.

7.5 Non-Communicable diseases

The final indicator is the number of OPD visits of patients with hypertension, diabetes, cardiovascular diseases or malignancies. These diseases combined are NCD's and grouped under non-acute health care services. Graph 8A shows that before the lockdown on average 80-100 patients with an NCD visited the OPD each month. During de LD, this number reduced with 82% (table 2). In the post-LD period, this number increased, but reached a level 36% below the reference period. This is further supported by the predictions of the ITSA, after the start of the lockdown the number of monthly OPD consultations reduced with 52 (p <0.001) and after the end of the lockdown this increased with 32 (p <0.001).



Graph 8A: Number of monthly OPD visits for an NCD during 2019 and 2020. The lockdown period is indicated in orange and post-lockdown period in grey.



	Value	p-value
Pre-lockdown		
Intercept	90.19	<0.001
Slope	- 0.875	0.452
Lockdown		
Level change	- 52.23	<0.001
Slope	- 9.50	<0.001
Slope LD-PreLD	- 8.625	<0.001
Post-lockdown		
Level change	32.43	<0.001
Slope	8.03	0.002
Slope PostLD-LD	17.53	<0.001

Graph 8B: result of the ITSA analysis of the monthly OPD visits for an NCD with the calculated trend lines during the Pre-lockdown, Lockdown and Post-lockdown periods.

8. Review of literature guided by the HBM

In this section, an overview is given of the current literature on altered health seeking behaviour during an outbreak or pandemic in Sierra Leone or similar other countries in West Africa (research question 2). The findings are discussed according to the five determinants of health behaviour, as described by the HBM (53): perceived susceptibility, severity, benefits, barriers and cues to action (figure 5).
In the HBM, both perceived susceptibility and severity contribute to perceived threats of a disease and because both determinants are interlinked, they will be discussed together.
The same applies to the determinants perceived benefits and barriers (or risks), are also discussed together since they both lead to an expectation on the outcome of certain health behaviour.

8.1 Perceived susceptibility and severity: threats

A central emotional response during a pandemic is fear, which may cause threats to appear more impending (55). According to the HBM, the perceived threat from COVID-19 is influenced by the perceived severity and susceptibility of the disease and builds on disease specific knowledge. Sengeh et al conducted a study on community knowledge, attitudes and practices in Sierra Leone, early in the pandemic (March 2020) (56). They found that knowledge about symptoms and outcome of COVID-19 was inadequate: only 33% of the study participants were aware that difficulty in breathing was an important symptom and 35% that a person can survive COVID-19. Hereby, overestimating the mortality rate (56). Another study, also conducted early in the pandemic, explored the influence of the Ebola outbreak on the disease perception of COVID-19. When comparing, study participant were quoted, stating that 'the diseases are the same' (57). Due to their previous experience they were aware of the risks of an infection and acknowledged that rules and regulations are needed in order to survive the COVID-19 pandemic, as was the case with Ebola (57). Both studies reported that the risk perception of COVID-19 in Sierra Leone is inadequate by overestimating the severity and mortality (56,57).

In Guinea, a study was conducted to explore the influence of previous experiences with Ebola on perceived susceptibility and threats of other diseases and eventual health seeking behaviour. They found that fearful memories from the Ebola outbreak seem to positively influence health-seeking behaviour for febrile illness, years later (58). This study was conducted before COVID-19 and whether this association upholds during the pandemic remains unknown.

Regarding perceived susceptibility of a disease, people tend to have an 'optimism bias', which is the belief that misfortune is more likely to affect other people rather than oneself, which might lead to underestimation of the risks to become infected or severely ill (55). A study from Uganda showed that the mortality of COVID-19 was perceived to be higher for people from Europa or the USA compared to Ugandan nationals, indicating that COVID-19 was perceived as a disease that affected 'the white race' more (59). The same study reported also that male study participants perceived themselves more at risk to get infected and become severely ill compared to the participating women (59). Interestingly, women are reported to be actually more at risk to attract COVID-19 because they are assigned to care giving roles, such as caring for sick and possibly infectious people (60). Additionally, knowledge and preventive actions were reported significantly higher in men compared to women (56). This possibly could be explained by a different perception of susceptibility, assuming that in Sierra Leone also perceived themselves more at risk like shown in Uganda (59).

Inadequate knowledge and perceived threat from a disease may stem from limited access to accurate health information (61). In rural communities in Sierra Leone, people rely mainly on the local radio for their information (57). In general, people living in rural areas rely more on widespread misinformation and anecdotal reports compared to their counterparts in urban areas, due to limited access to information tools, few social media channels and poorly developed strategies for crisis communication (61).

To summarize, these study findings indicate that people perceived a high and disproportional threat from COVID-19 in the beginning of the pandemic and may underestimate their susceptibility, particularly women. It would be very interesting to get more insight in how the perceived for known and common illnesses change during a pandemic. Unfortunately, no studies on this subject were found.

8.2 Perceived benefits and barriers: outcome expectations

Another important element is what people would expect in terms of the outcome of their health behaviour including expectations regarding availability and quality of health care services and which barriers people expect to encounter. During Ebola, people had experienced that HCW's were absent or unwilling to treat patients with fever and health facilities were dysfunctional due to a diversion of resources and deaths among HCW's (3). Also in the COVID-19 outbreak, a diversion of resources was observed, away from regular programs, for example the TB program (48). Across many LMIC, a diversion of resources affected the quality of maternal and newborn health services (34).

In Sierra Leone, a study was conducted across public health care facilities during the lockdown reporting that a majority of health care workers (HCW) indicated that their facility was poorly prepared caused by insufficient supplies of PPE and hand soap or sanitizer. Only half of the HCWs felt confident to provide medical care for a COVID-19 suspected patient, while they had adequate knowledge and were adherent to preventive methods (37). This indicates that also for COVID-19 related care, quality may have been poor. Another important aspect of the expectations of outcome of care is what happened to patients with confirmed COVID-19. During the Ebola outbreak it was very challenging for people to see their relatives being transported far away to treatment centres and in many cases not being able to conduct funeral ceremonies (3).
For COVID-19, a similar policy was in place: a positive COVID-19 test result meant immediate and unannounced relocation to a treatment centre, away from relatives. The main purpose was to isolate COVID-19 patients, while they were managed in the best possible way with scarcely available equipment like ventilators and oxygen concentrators (31). This policy also applied to all patients, also to the substantial proportion with a mild and asymptomatic disease course (11). During the Ebola outbreak, these policies led to a breakdown of trust between communities and the health care providers, because they were perceived inhumane and undignified (3). These parallel policies with the previous Ebola outbreak may have influenced the perceived benefits negatively and possibly acted as a barrier to seek healthcare.

Additional important factors that may act as barriers in health behaviour are the roles of stigma and fear. As indicated in the beginning of this section, fear is a very central emotion in a pandemic (55). In several studies, fear is described to influence perceptions and health behaviour during a pandemic (3,34,48,58). In a study from Nigeria, participants were asked to rate their level of fear for COVID-19. On average participants rated 7 out of 10 and a quarter of all participants indicated that they did not want to be

associated with someone recovered from COVID-19, indicating stigmatization (62). Among people recovered from Ebola, stigma is also very prevalent and related to experiences of social exclusion, verbal abuse and fear of contagion(63). In relation to healthcare utilization, Ebola survivors who had experienced health care neglect, tended to seek healthcare in the informal and traditional sector (63).

Fear may be a useful emotion in a pandemic, because it is an important driver for behaviour change, for example adherence to public health measures (55). However, fear does not always have the desired effect and may backfire (64). When people perceive a high level of efficacy, fear may have the desired effect, but when a low level of efficacy is perceived it may act as a barrier, leading to defensive or avoiding behaviour (64). During the COVID-19 outbreak, fear had several dimensions, including fear to be infected with COVID-19 when seeking healthcare and fear to be quarantined and isolated from family members when positive (34). During the Ebola outbreak, fear was reported as a main driving factor for a decline in utilization of health care services (3,45).

8.3 Cues to action

The HBM also describes how cues may activate people to seek healthcare including health messages or experiencing symptoms. A study from Cameroon during the first wave of the COVID-19 pandemic reported that only a minority of their participants (23%) took adequate action to seek healthcare when experiencing multiple COVID-19 symptoms. This hesitation was caused by fear to get infected in the hospital, stigmatization and being misdiagnosed (65). This example highlights that experiencing symptoms may not necessary lead to the desired behaviour.

In general, effective communication is very important during a pandemic since many types of misinformation, fake news and conspiracy theories are circulating (55). During the Ebola outbreak, health messages were disseminated to counteract the denial about the existence of Ebola and conspiracy theories, emphasizing the severity and absence of a treatment or vaccine (66). These messages unintentionally promoted home-based care for Ebola patients in Sierra Leone as people had understood that no treatment was available in health care facilities (66). The same study described how subsequent health messages were designed through a two-way approach with community stakeholders, to maximize the chance to be correctly utilized (66). In addition to this two-way approach, general insights on risk communication stress the importance of a reliable and trustworthy source and emphasis on benefits, protecting others and appealing to a social consensus or moral norm (55).

9. Discussion

The results of the quantitative analysis indicate that the utilization of hospital services was substantially reduced during the LD period in the LHMC and partially normalized to preceding rates of utilization during the post-LD period. Different patterns of under-utilization were observed between different patient groups. General hospital services and services related to maternal health were severely, but temporarily affected. Among the indicators related to child health, we observed a different pattern. Utilization of hospital services was reduced with 88% during the LD and remained 54% below the normal level during the post-LD period. For patients with HIV and/or TB, OPD visits were also significantly reduced and analysis of sputum samples to diagnose TB was even completely discontinued during the LD period. For the patient group with NCD's, utilization of hospital services was substantially reduced during the LD-period and only restored partially in the post-LD period. When comparing acute with non-acute hospital care, both types were equally affected during the LD-period in contrast to the post-LD period when only non-acute services remained under-utilized. This applied particularly to patients attending the OPD for HIV, TB or NCD's, while general OPD attendance levels had restored. The results of the quantitative analysis did not reveal significant differences between utilization of services between male and female patients.
The number of adult patients presenting with respiratory symptoms were included in the analysis to give an indication of the range of COVID-19 suspected patients and associated burden. Since reliable COVID-19 reports at hospital level were not available and cases may have been underreported, this indicator seemed most adequate. During LD and post-LD periods, reductions of respectively 91% and 70% were observed, indicating that a limited number of adult patients with respiratory symptoms visited LHMC.

The most alarming finding is the 88% and 54% reduction of children visiting the OPD with malaria during respectively the LD period and post-LD periods. The LD period coincided with the rainy season when a rise in malaria cases is normally observed. A similar pattern of reduced utilization was seen in children with an ARI. This is worrisome, because malaria and ARI are together responsible for 32% of the under-five deaths in Sierra Leone (67). A possible explanation for this reduction may be found in the similar presentation of children with COVID-19, ARI or malaria. Most children have symptoms such as fever and shortness of breath and based on clinical presentation it is not possible to distinguish between the diseases (41,42). Additionally, the suspicion for COVID-19 in malaria endemic areas is often low and testing in this age group poses challenges (68). For clinicians it may be unclear how to approach under fives with COVID-19 like symptoms (42).
As described in the literature overview, health-seeking behaviour likely changed during the pandemic. Due to widespread misinformation and fear to be associated with COVID-19, to attract COVID-19 and to be stigmatized, parents may avoided regular health care services (34,43). Another report from Sierra Leone reported a significant decrease in the number of diagnosed under-five malaria cases in a community health centre in April 2020, during de lockdown, but not in subsequent months as we observed in the analysis (69). The difference may be explained by local variations in information strategies aiming to reduce misconceptions and promote health behaviour. Another possibility is that parents may have felt more comfortable to seek healthcare in a health centre compared to a hospital.

Ngo *et al* estimated, based on utilization rates during the Ebola outbreak in Sierra Leone, that the under-five population had suffered from 21% of excess mortality, far exceeding the death toll from Ebola in all age groups (70). This illustrates the potential excess mortality in the under-five population during the COVID-19 outbreak. The results of the quantitative analysis show considerable reductions in utilization rates in the under-five population that continued when utilization of other services had restored to

normal levels. It is plausible that the under utilization of under-five health services has led to indirect morbidity and mortality, similarly as happened during the Ebola outbreak.

Patients with TB an/or HIV were actively encouraged to extend the intervals between their follow-up visit from 1 to 3 months to alleviate hospitals (48). This would partially explain the reduction in utilization during the LD period in this patient group, but not in the post-LD period, when the normal one-monthly follow-up visits were reinstated. Another possibility for reduced utilization is, similar to the child health indicators, the overlapping symptoms between TB and COVID-19 and altered health-seeking behaviour. The complete discontinuation of sputum sample analysis may me explained by patients with chronic respiratory symptoms avoiding the health system or when visiting the hospital they might have been suspected of COVID-19, tested and not further assessed for other diseases. Another possibility is that laboratory staff may have been hesitant to handle sputum samples and feared to acquire COVID-19.
It is not very likely laboratory staff was overburdened with taking COIVD-19 samples, since the overall number of patients with respiratory symptoms was very limited.
Either way, hospital services for patients with or suspected of TB were greatly underutilized during the LD-period. This may reflect a decline in quality of TB services and presumably led to undiagnosed TB cases (48). An analysis on the impact of COVID-19 on TB and HIV services across LMIC's described that the main barriers to access services included fear to get infected with Sars-CoV-2, transportation challenges and movement restrictions (71). The WHO reported that the COVID-19 pandemic caused significant disruptions of TB services, leading to a reduction of 21% of people receiving TB care and an estimated half million excess TB deaths worldwide (72).

The under-utilization of services related to chronic care may be explained by the perceived severity of a disease, which is most likely less for chronic compared to acute hospital care. People perceiving more severity may overcome the fears and barriers of the COVID-19 pandemic more easily compared to patients who have complaints they perceive less urgent en less life threatening. Still, patients suffering from a disease with a more chronic character are in need of healthcare and prolonged withdrawal from treatment may lead to a worsening of their disease or complications. In patients with HIV for example, an interruption of treatment is an important determinant for HIV-related mortality (47). From a public health perspective, it is also not desirable that patients with TB or HIV withdraw from treatment since this may lead to the development of resistant strains.

Surprisingly, the number of adult patients with respiratory complaints (ARI) dramatically reduced during both the LD and the post-LD periods indicated that very few patients with COVID-19 like symptoms utilized health care services. This finding builds further on the recurring pattern in our results showing that patients with diseases who share common symptoms with COVID-19, disproportionally under-utilized hospital services. The health messages that were propagated during the pandemic to seek healthcare when experiencing symptoms that may resemble COVID-19, did not seem to have the intended effect. Our study findings point towards an opposite effect, of people avoiding formal health care facilities when having symptoms similar to COVID-19. This is supported by study findings from Cameroon indicating that a majority of study participants did not seek healthcare when experiencing symptoms due to fear and stigma (65). Additionally, a study on excess mortality in Somalia reported that stigma surrounding COVID-19 and fear not being able to see family members once admitted, drove people away from seeking care in hospitals for relatives with COVID-19 like symptoms (73).

During previous outbreaks of Zika and Ebola in West Africa, the healthcare needs of women were not met due to a diversion of resources away from reproductive healthcare towards the emergency response. Based on these experiences, concerns have been expressed about further worsening of gender

inequities during the COVID-19 pandemic (20). In the analysis of the study result, institutional deliveries were reduced with 66% during the LD-period. Although this quickly normalized after the lockdown, many pregnant women did not receive the obstetric care they needed. Based on previous hospital records (table 2), LHCM would expect to attend to roughly 100 women in labour with complications during the three months of the LD-period. Instead, only 34% of women utilized these services, leaving the remaining 66% deprived of specialized care including the possibility to conduct a caesarean section when needed. The resulting morbidity and mortality may go unnoticed when women deliver at home. Potentially, the already high MMR in Sierra Leone (4), may have further increased during the COVID-19 pandemic. This is supported by the findings of a meta-analysis reporting that maternal and foetal deaths have increased since the COVID-19 pandemic, particularly in LMIC's (74).

In the literature overview, fear was repeatedly described as a major barrier in the perceived outcome of health behaviour, because people feared to get infected, stigmatized and isolated (34,65). In the setting of a pandemic, fear or a high risk perception for COVID-19 may be useful because people tend to adhere more to public health instructions (55). Fear may have the opposite effect when people perceive low efficacy levels (64). Additionally, fear was directed towards the health system as people mainly feared to acquire COVID-19 while seeking healthcare. All together, fear is a central emotion in a pandemic and in Sierra Leone may have driven people away from the formal health care system. Similarly to the Ebola outbreak, fear seems to be a main driving factor of underutilization of hospital services (3,21,23,24).

From the beginning of the pandemic severe concerns were expressed if the lockdown measures for COVID-19 would outweigh the indirect damage (33). Certainly when taking into account that containment and closure policies for COVID-19 have been shown to be epidemiologically less effective in LMIC's (75), this is a very relevant question. The findings of this study indicate that under-utilization of hospital services during the lockdown was substantial and presumably led to indirect morbidity and mortality, while the number and burden of COVID-19 cases was limited. Although it is difficult to quantify the indirect effects, when expanding these findings to a national level, there is a very stark contrast with the burden of COVID-19 in Sierra Leone, where at the time of writing, the official statistics counted 4168 confirmed cases and 79 deaths (5). It is very likely that many COVID-19 cases have gone unnoticed since patients with COVID-19 like symptoms avoided the healthcare system. But, even when accounting for underreporting, the burden of COVID-19 in LMIC is estimated to be less compared with HIC (76).

In addition to very strict and possibly disproportionate COVID-19 measures, important opportunities were missed out on. When communication strategies are designed in collaboration with communities, people may had received information that was aligned with their situation, provide reliable information and reduced fear (55). Another important lesson that can be learned from these findings is that many reasons for fear where directly related to the healthcare system. Similar to Ebola, fear and distrust seemed main driving factors for under-utilization of healthcare. This calls for rebuilding trust in the healthcare system and policies applied in outbreak management.
At last, while its was already known from the previous Ebola outbreak that vulnerable groups were disproportionally affected (3), no specific measures were taken to facilitate that pregnant women, under-five children and chronically ill were still able to access care. A particular concern for the on-going pandemic in LMIC is how to approach the common symptomatology of COVID-19, malaria and ARI in under-five children (41). As COVID-19 cases have started to rise in Sierra Leone during the course of 2021 and new variants emerge, these concerns are even more relevant.

9.1 Limitations

The main limitation of the study was that only one institution was included in the analysis and that for some indicators the size was relatively small. Additionally, this institution was located in a rural area. Therefore, these findings may not be generalizable for the whole of Sierra Leone but only for institutions in a comparable (rural) setting. Additionally, it is important to keep in mind that the time frame of interest involved the first wave of the COVID-19 pandemic, early 2020 and the period afterwards. Due to the rapid evolving nature of a pandemic, the findings may not be representative for periods later on in the pandemic from 2021 onwards.

Another limitation is that the scope of this thesis is narrowed down to utilization of health care services and health seeking behaviour. The entire array of social, economic and political influences during the pandemic has not been addressed. The HBM is a very useful as a guide to understand health behaviour, but may have its limitations in a pandemic setting, because access to and provision of healthcare services are not addressed. Also, in this study provision of health care services were not assessed, but merely looked at utilization and assumed continued provision of health care services, which may not have been the case. It is however important to realize that coverage of health care services consists of a demand and supply side and in this thesis we explored the demand side by evaluating utilization. Provision of health care services may be compromised by a diversion of resources or shortages of HCW's.

Finally, it was very challenging to provide an accurate and evidence-based description of the scope of COVID-19 in LHMC and Sierra Leone. Since testing for COVID-19 was irregularly available and numerous test results got missing, the statistics on COVID-19 cases in LHMC were incomplete. Therefore, these were not included in the analysis. Instead, all ARI cases in adolescents and adults were included with the additional advantage that unrecognized COVID-19 cases would be included as well. The official statistics of COVID-19 are shown in figure 1, but this may be an under-representation since testing capacity is limited and patients with COVID-19 like symptoms may have avoided the healthcare system. Although not the aim of the thesis, a better understanding of the full scope of COVID-19 infections and associated burden would enable to view under-utilization and subsequent indirect effects during the COVID-19 pandemic in a more accurate perspective.

10. Conclusion and recommendations

The findings of this study show that during the LD-period, hospital services were underutilized by all patient groups within the range between 33 to 88% below the normal level. After the LD period normalization in utilization of services was observed in services with an acute character and services related to maternal health. This however did not apply to all patient groups. Under-five children with malaria or ARI continued to under-utilize health services in the 6-month period after the lockdown 54% below the normal level. Additionally, patients with chronic conditions (HIV, TB, NCD's) utilized non-acute services also below normal levels. Presumably, under-utilization of hospital services led to indirect morbidity and mortality. Within the patient groups that disproportionally under-utilized healthcare services, we observed a pattern of overlap between symptoms with COVID-19. Presumably, fear and stigma were barriers for people to seek healthcare, similarly to the Ebola outbreak.

At all times, the benefits of controlling an infectious disease should be weighed against the indirect damage that is caused. This may be challenging in the acute response when the potential harm caused by the infectious agent is not entirely clear. In this study we touch upon the under-utilization of health services, potentially leading to indirect health damage particularly in vulnerable groups. As the COVID-19 pandemic continues and its direct impact becomes more clear, it is essential to safeguard vulnerable populations, such as under-fives, pregnant mothers and chronically ill from indirect harm.

The main recommendation following the results of this study is to develop strategies and prioritize continued utilization of health services while responding to an outbreak at the same time. Since fear seems a major driving factor for under-utilization, these strategies should focus on risk communication and community engagement to reduce fear and build trust. Of particular concern is the under-five population who often suffer from diseases with COVID-19 like symptoms and in our study mostly under-utilized health care services. This leads to the recommendation to develop a specific strategy aimed at the parents of under-five children to support them in seeking health care when their child falls ill and reduce fear and stigma particularly in this group. Since the COVID-19 pandemic is on going and cases have started to rise again in Sierra Leone in 2021 leading to new restrictions, this remains relevant.

Furthermore the findings of this study stress the importance of evaluating the indirect effects of COVID-19 measures. Without this information unintended harm may go unnoticed and it would be difficult for policy makers to weigh these unintended effects in decisions about measures to control a disease. An additional recommendation is therefore to assess indirect effects on a national scale by evaluating utilization rates, health care provision of non-COVID-19 related services and possibly excess mortality.

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