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THE IMPACT OF COVID-19 RESTRICTIONS ON THE PROVISION OF MATERNAL HEALTH SERVICES AT MBUYA NEHANDA MATERNITY HOSPITAL, PARIRENYATWA GROUP OF HOSPITALS, HARARE

BY

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Abstract

The recent coronavirus disease 2019 (COVID-19) pandemic has had a disastrous effect on the healthcare delivery system on a global scale, but pregnant women face unique challenges. In Zimbabwe, the public health measures for infection control of COVID-19 focused on lockdown of people in their homes and physically restricting movement. The purpose of this study is to assess the impact of these measures on the delays to the provision of essential maternal health services. The Thaddeus & Maine Three Delays Model was utilized focusing on the second delay, the ability of pregnant women to access antenatal services, trend in admissions for delivery and maternal deaths. The research hypothesis is that maternal morbidity and mortality increased because of COVID-19 lockdown restrictive measures. The number of ante-clinic (ANC) visits decreased significantly ($p<0.001$) from a pre-lockdown mean of 208.1 ±52.50 to 88.4 ± 9.40 during lockdown. The volumes of admissions and maternal deaths did not differ significantly ($p=0.220$) between the pre-lockdown era (Mean=905.8 ±431.71) and during lockdown (Mean=742.5 ±95.17). Compared to the pre-COVID-19 period, the odds of presenting with pregnancy complications doubled during the COVID-19 lockdown (OR=2.0; 95% CI: 1.5 - 2.8, $p=0.050$). The ANC visits decreased during lockdown ($p<0.001$) pre-lockdown (M=208.1±52.50) and during lockdown (M=88.4±9.40). The total admissions are not significantly different ($p=0.22$) during lockdown, pre-lockdown mean (M=905.8±431.71) and during lockdown (M=742.5±95.17). The referral admissions are not significantly different ($p=0.195$), pre-lockdown mean (M=828.3±476.77) and during lockdown (M=636.3±88.34), compared to direct admissions that are also not significantly different during lockdown ($p=0.49$), pre-lockdown mean (M=77.58±105.56) and during lockdown (M=106.25±=94.64). The maternal deaths are not significantly different ($p=0.64$), pre-lockdown mean (M=2.50±1.38) and during lockdown (M=2.17±1.99). The complications found in high-risk pregnancies are anemia in pregnancy, Bartholin's abscesses, big abdomen, big baby, bleeding, breach baby, born before arrival, COVID-19, diarrhea, fetal distress, gestational diabetes, multiple pregnancies, painful varicose veins, preeclampsia, preterm labour, previous caesarian procedure, thick mucus, thick muscle, threatening miscarriage and vaginal wall tear. Healthcare workers highlight that lockdown roadblocks, transport availability and delays to reach MNMH impacted maternal healthcare delivery. There was no evidence that mobile telephone services were utilized for tracking and communicating with pregnant women in the pre- and during lockdown period.

Key words: COVID-19 lockdown; Three Delay Model; Telemedicine

Declaration Page

I declare that this dissertation is my original work except where sources have been cited and acknowledged. The work has never been submitted, nor will it ever be submitted to another university for the award of a degree.

Noah Mandoza February 21st, 2022

Student's Full Name and Signature (Date)

Dr. Julia Maradzika 16th March 2022

Main Supervisor's Name and Signature (Date)

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I would never forget to pay thanks to my wife and children for their wise counsel, sympathetic ear, love, my source of courage and confidence.

Dedication

I dedicate this research work to the pregnant women in Zimbabwe who face adversity and vicissitudes during pregnancy when there are emergencies and national disasters. May the impact of this work be the lens to see the systemic weaknesses and nudge the policy makers to construct a safe environment for pregnant patients to access health care and deliver safely.

List of Acronyms and Abbreviations

AIDS	Acquired Immuno-deficiency Syndrome
ANC	Antenatal Clinic
AUREC	Africa University Research Ethics Committee
BBA	Born before arrival
COVID-19	Coronavirus Disease 2019
ICT	Information Communication Technology
KPMG	Klynveld Peat Marwick Goerdeler
MNMH	Mbuya Nehanda Maternity Hospital
MoHCC	Ministry of Health and Child Care
OR	Odds Ratio
PPH	Post-partum Hemorrhage
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SOP	Standard Operating Procedure
UNDP	United Nations Development Programme
USAID	US Agency for International Development
WHO	World Health Organization

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CHAPTER 1 INTRODUCTION

1.1 Introduction

The COVID-19 was first identified in Wuhan City, Hubei Province, China, in December 2019 and declared a 'national disaster' in Zimbabwe on the 27th of March 2020. The coronavirus disease 2019 (COVID-19) pandemic presented challenges to the maternal healthcare cascade in Zimbabwe. The nationwide lockdown gazetted by the Government of Zimbabwe following the novel coronavirus pandemic is investigated to determine if it had a domino effect on pregnant women's health care. This study aimed to add to the body of knowledge by investigating the effects of the COVID-19 pandemic mitigation strategies on access to maternal healthcare services. Research is conducted to find out if there was deprioritization of pregnant women's access to pertinent health services and if the health services structure provides an enabling environment for communicating with pregnant women and triage to care. The Three Delays Model was used as a framework to show when the delays to care were predominant. Hence this study filled the information gap on the impact of the pandemic induced lockdowns on maternal healthcare.

Pregnancy related morbidity is the driver for the need to reach maternal healthcare. It covers hemorrhage, pregnancy induced hypertension, unsafe abortion, sepsis, gestational diabetes, and multiple pregnancy. The study assessed how the COVID-19 lockdown restrictive measures impacted maternal health services at Mbuya Nehanda Maternity Hospital (MNMH), pre- (March 2019 to February 2020) and during the

COVID-19 pandemic (March 2020-February 2021). This provided a lens to see the resilience of the maternal healthcare system in Zimbabwe when faced with a national disaster or epidemic.

It also assessed the capacity to utilize information communication technology (ICT) for telehealth and telemedicine. Telehealth or telemedicine as a pillar of healthcare resilience presents an opportunity to develop new health care models. There was probing for high-level challenges on the adoption of ICT by the MNMH, information systems integration, and whether there was efficiency in the delivery of maternal health services.

1.2 Background to the Study

In Zimbabwe, the government declared the COVID-19, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, a 'national disaster' on the 27th March 2020 (Clare, Dube, Moyo & Ngwenya, 2020). The COVID-19 was first identified in Wuhan City, Hubei Province, China, in December 2019. The symptoms of the disease which appear 2-14 days after exposure to the virus include fever or chills, dry cough, tiredness, shortness of breath and dyspnea (Dzinamarira, Mukwenha, Eghtessadi, Cuadros, Mhlanga & Musuka, 2020). This study assesses the impact of the COVID-19 public health restrictive measures on the provision of essential maternal health services focusing on the second delay critical control point of intervention as given in the Three Delays Model (Thaddeus & Maine, 1994). Figure 1 shows the second delay in the Three Delays Model of maternal health.

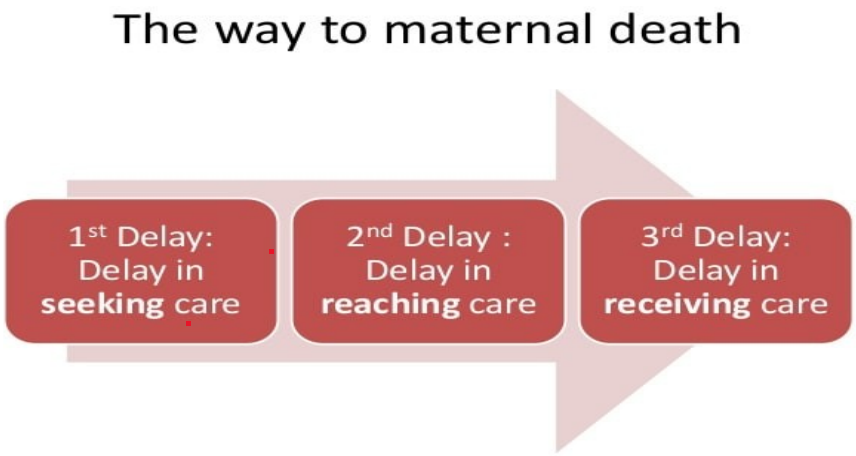

Figure 1 The Three Delay Model

Pursuant to WHO guidelines to contain the COVID-19 pandemic and minimize the incidence of new cases, the Government of Zimbabwe introduced lockdown measures. These restrictive measures were meant to maximize physical social distancing by making people stay home. Travel restrictions were enforced and policed by having roadblocks on all major roads. All customer service centers that draw crowds were closed, and this included antenatal clinics (ANC). This study aims to assess the impact of the COVID-19 lockdown restrictive measures on the provision of maternal health services. Since the measures restricted movement, the study will look at indicators around the second delay of the Three Delay Model, Delay in Reaching Care.

Maternal health services, which include antenatal care, delivery care, and postnatal care, can play a crucial role in preventing maternal and neonatal morbidity and mortality. The recent COVID-19 pandemic has had a disastrous effect on the healthcare delivery system of people of all ages, on a global scale but pregnant women face unique challenges (Pant, Koirala & Subedi, 2020). At the outset of the

COVID-19 pandemic the precise extent of the risks in pregnancy was uncertain. This is likely to have affected pregnant individuals' mental health, increased pregnancy-related morbidities as third-trimester vaginal bleeding, pregnancy-induced hypertension, preeclampsia, eclampsia, hemolysis, preterm labor, infections requiring antibiotics, or any other pregnancy-related conditions requiring treatment or referral.

1.3 Statement of the Problem

The indirect effects of COVID-19 lockdown public health restrictive measures (restricting movement of people, lack of public transportation, physical/social distancing, closing of health facilities, reduction antenatal clinic (ANC) visits, and timely access to health facilities when pregnant women are due for delivery) impact the delivery of maternal health services. Akaba, Dirisu, Sulieman & Edeh (2020) developed a social ecological model that shows the barriers to reaching care as in Figure 2. The factors are premised around the community where pregnant women reside. The determinants of maternal morbidity and mortality can be prevented by giving prompt, suitable treatment to pregnant women. Maternal health services, which include antenatal care, delivery care, and postnatal care, can play a crucial role in preventing maternal health problems. Hence the study focuses on the impact of the recent COVID-19 pandemic on the maternal healthcare delivery as Zimbabwean women faced barriers to movement due to travel restrictions. This study will show if accessing maternal health care was impacted and if subsequently there was a rise in maternal morbidity and mortality.

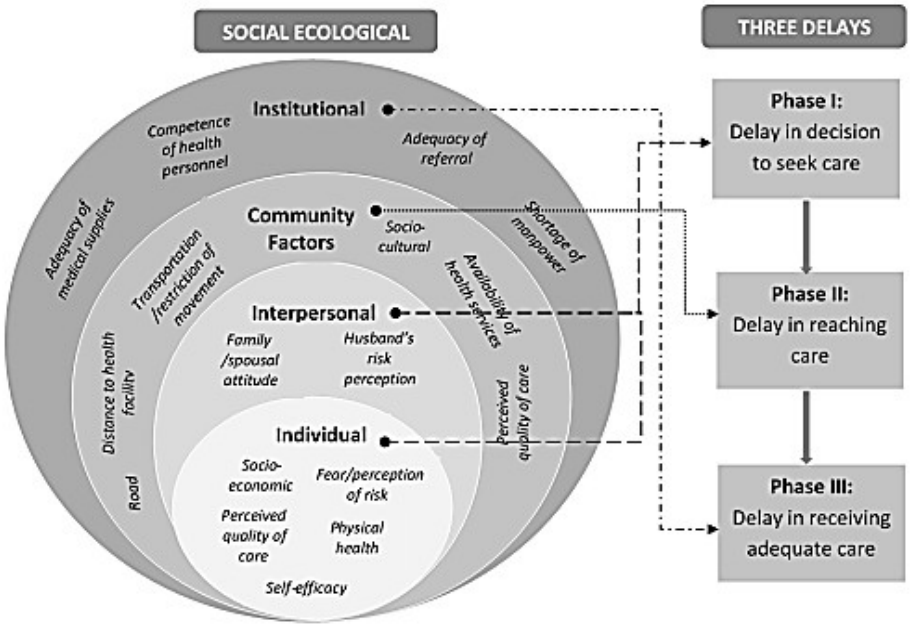

Figure 2 The Three Delays and the Social Ecological Models for Delay in Reaching Care (Akaba et al, 2020)

1.4 Research Objectives

1.4.1 Broad objective

The aim of this study is to assess the effect of COVID-19 lockdown restrictive measures on provision of maternal health services at Mbuya Nehanda Maternity Hospital (MNMH), pre- (March 2019 to February 2020) and during the COVID-19 pandemic (March 2020-February 2021), specifically looking at the capacity of pregnant women to reach care in such an environment. The national lockdown restrictive measures were meant to mitigate rapid COVID-19 infection by minimizing movement and mingling of people, however, the delay in reaching care has significant implications on maternal morbidity and mortality. It is important to understand how pregnant women's physical and mental health is affected by the

implementation of recommended public health guidelines for reducing viral transmission during this pandemic.

1.4.2 Specific Objectives

a. To assess the impact COVID-19 lockdown restrictive measures in pregnant women's ability to reaching care, the 2nd Delay of the Three Delay Model, at MNMH pre- (March 2019 to February 2020) and during the COVID-19 pandemic (March 2020-February 2021) by determining if there was a statistically significant decline in antenatal clinic visits (ANC) and admissions in either year.
b. To highlight which obstetric complications, pre- (March 2019 to February 2020) and COVID-19 (March 2020-February 2021) lockdown period, were recorded when pregnant women presented for admission to MNMH, and those highlighted by healthcare workers.
c. To determine the likelihood of increased pregnancy-related risks when exposed to the COVID-19 lockdown, with compromised access to maternal health services, with the lockdown as a determinant of maternal morbidity or mortality, for pre- (March 2019 to February 2020) and COVID-19 (March 2020-February 2021) lockdown period.
d. To assess if maternal mortality increased during COVID-19 lockdown comparing pre- (March 2019 to February 2020) and COVID-19 (March 2020-February 2021).
e. To check if the MNMH management system has capacity for telehealth, telemedicine, mobile phone communications or virtual platforms for maternal

healthcare, pre- (March 2019 to February 2020) and COVID-19 (March 2020-February 2021) lockdown period.

1.5 Research Questions

a. Was there a statistically significant decline in antenatal clinic visits (ANC) and admissions when comparing the pre- and during COVID-19 years?
b. Which obstetric complications presented during either year as recorded in registers or as highlighted by healthcare workers?
c. What was the likelihood of increased pregnancy-related risks when exposed to the COVID-19 lockdown?
d. Did maternal mortality increase during COVID-19 lockdown?
e. Does the MNMH management system have capacity for telehealth, telemedicine, mobile phone communications or virtual platforms with pregnant patients?

1.6 Assumptions or Hypothesis

a. Assumptions: The data collected from maternity registers and monthly reports is accurate. The healthcare respondents answered all questions honestly, and the sample is representative and homogenous.
b. Hypothesis: The research hypothesis is that COVID-19 lockdown restrictive measures caused adverse maternal health outcomes.

1.7 Significance of the Study

This study will provide an insight into whether the maternal health delivery system was compromised during the COVID-19 pandemic by the national policies mandated

by the government to mitigate the rate of infections. Delivery of children cannot be delayed or deferred, and the pregnancies are associated with complications that can increase maternal mortality. Since the availability of essential health services for pregnant women cannot be delayed or shifted to other settings, it is essential to address the indirect impact of COVID-19 on maternal health. Hence this study shows if the maternal healthcare was considered, prioritized and accommodations made to ensure continuity of care and safe deliveries. This allows introspection into the vulnerability and resilience of the maternal healthcare system and interrogates the capacity-building necessary to ensure safe delivery during a pandemic. Since there is little data available for the indirect impact of COVID-19 pandemic public health measures on maternal morbidity and mortality, this study will fill the knowledge gap by providing findings in relation to which critical maternal healthcare services were not accessed because of the lockdown restrictive measures.

1.8 Delimitations of the Study

a. The convenient sampling of a single maternal healthcare facility, MNMH, was done considering the prevailing COVID-19 constraints, and time constraints, as opposed to doing a national health facilities survey.
b. The participants are chosen from the pregnant women who presented to the MNMH ANC clinic and those admitted for delivery.
c. The study focuses on the pre- (March 2019 to February 2020) and COVID-19 lockdown (March 2020-February 2021) twelve-month periods.

d. The quantitative study relies on routinely collected data from the ANC and admissions registers, and the MoHCC HS3/6 Hospital Statistics Monthly Return Forms at MNMH.

e. The samples for determining if the lockdown exposed pregnant women to increased risk were calculated from the pre- and during COVID-19 periods, and that for qualitative study was selected for doctors and nurses that worked during the period of study.

1.9 Limitations of the Study

a. The research design and sampling strategy may make it difficult to generalize the findings to national level, it being a single-center study at a tertiary hospital so generalizability cannot be assured.

b. Choice of doctors and nurses from one setting is likely to limit the generalizability of the results as healthcare workers in other settings could have different experiences.

c. Administration of the qualitative tool, the questionnaire, following COVID-19 guidelines of physical distancing reduces ability to collect more in-depth information through probing questions.

d. The research model did not collect data on the possible confounders and determinants (gravida status, vaginal/caesarian births, history of bleeding, cardiovascular problems, knowledge, attitudes, and socio-economic status) of maternal morbidity and mortality because of physical social distancing research protocol that prevented extending to pregnant subjects.

e. The association between pregnant individuals with COVID-19 diagnosis to higher rates of adverse outcomes, including maternal mortality, preeclampsia, preterm birth, and other risks could not be established as COVID-19 testing and screening was not mandatory during the time of study.

1.10 Summary

The research focus is to determine if the COVID-19 pandemic lockdown restrictive measures present challenges to the resilience of the maternal health service. The comparisons of scenarios for the pre- and during COVID-19 12-month periods assists in determining if delay to access healthcare occurred. The other objectives premise on whether the exposure to COVID-19 restrictive environment impacted on the maternal morbidity and mortality. The study also provides a lens into the robustness of the maternal healthcare and its ability to provide healthcare by using internet or mobile technology.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The outbreak of coronavirus disease 2019 (COVID-19) brought a transformative shift in many health systems globally posing unprecedented challenges and opportunities to improve healthcare services delivery. The virus was declared a public health emergency and a global public health concern by the World Health Organization (WHO) on January 30th, 2020. Immediately after the pronouncement, many countries imposed stringent measures including social distancing, the mandatory wearing of face masks in public places, self-isolation and quarantine of suspected and positive individuals, a temporary ban of public gatherings, closure of borders, sanitization, temperature checking at strategic entry points and curfews to reduce further transmission and the catastrophic impact of the virus (Mbunge, E., Muchemwa, B., & Batani, J., 2022).

The COVID-19 pandemic crosscutting impacts, individual country responses, and the state of preparedness of local public health systems greatly vary across the world. Of significance is that social restrictions public health measures have challenged the care of pregnant women. Pan, Koirala & Subedi (2020) assessed the effect of COVID-19 on access to maternal health services from journal articles. They found that women worldwide are facing more barriers to accessing maternal health care, transport challenges and anxiety over possibly being exposed to coronavirus and as a result, a considerable rise in maternal mortality globally has been estimated over the next six months. WHO (2020) recommended that ante-natal clinic (ANC) services

which involve large gathering of beneficiaries could be suspended in view of restricted movements and the need for physical-distancing. It encouraged that telephonic contact should be made, for pregnant women on an intra-partum list, during last trimester to ascertain status and home-based follow-up to be provided if necessary.

2.2 Theoretical framework and variables

The theoretical framework for the study is premised on the Three Delays Model of maternal healthcare as in Figure 3 below. The key factors to consider when the first delay, Delay in Seeking Care, occurs are in the domain of the individual and interpersonal. The pregnant woman and people around her include the spouse can influence and support her to seek maternal health timely. However, for socioeconomic reasons and lack of knowledge this might not happen, especially when there is a ravaging COVID-19 pandemic. To create an enabling environment for empowering pregnant women interventions are proposed at facility level and at national level as in Figure 3. Capacity-building in telehealth is envisaged for the delivery of maternal health services during the COVID lockdown. It provides the hybrid environment of remote health services and in-person call for physical checks or for delivery. The government support is required in mobilizing fiscal funding support for the telehealth infrastructure and for manpower training. Where the second delay, Delay in Reaching Care, the key factor is the community or government which must provide for seamless access to health facilities in all scenarios. At facility level, there could be availing of transportation options. However, the effective use of telehealth can enable triage of pregnant women

complications and trigger speedy access to health services. The literature review and the study will focus on the conceptual framework of maximizing telehealth under the COVID-19 pandemic environment.

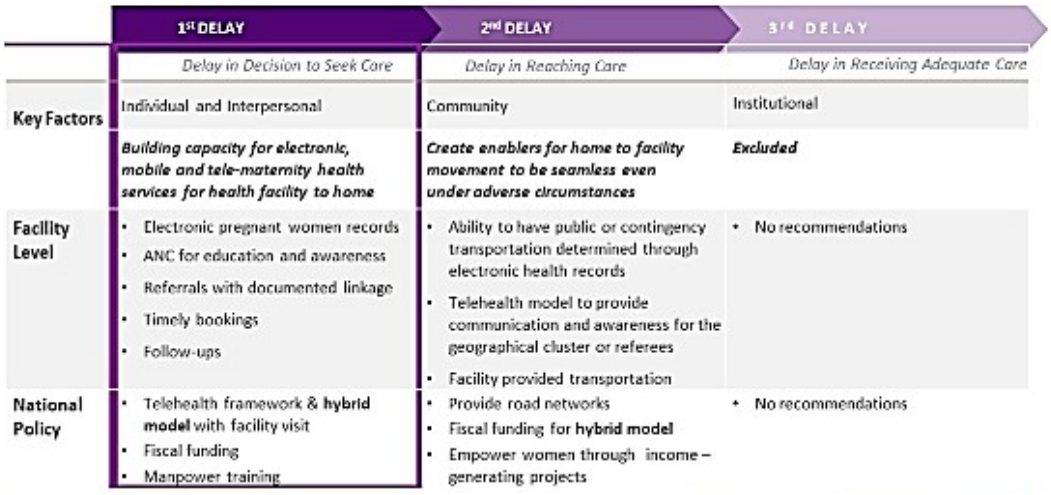

Figure 3 Conceptual Framework for the Mitigation of the 2nd Delay to Maternal Health

The eligible subjects included for the study were the pregnant women who presented at the MNMH ANC clinic and the MNMH admission for delivery during the period March 2019 to February 2021. The justification is that the study focused on the 2nd Delay, Reaching Care, to generate information on how the COVID-19 pandemic movement restrictive measures impacted pregnant women's access to maternal healthcare. The healthcare worker questionnaire tool included all skilled personnel that worked during the period March 2019 to February 2021. The 1st and 3rd delays were excluded in this study. The 1st delay is experienced due to individual factors (socio-economic, perceived quality of health care, self-efficacy, fear, perception of risk and physical health) and interpersonal factors (family and spousal attitude, and

husband's perception of risk), was excluded because it needed the pregnant women cohort to provide responses. Assessing this relationship was not possible during the COVID-19 social distancing measures. The 3rd delays due to institutional factors prevailing at the health facility (adequacy of medical supplies, competence of health personnel, adequacy of referral and shortage of manpower), was excluded as the focus is on the impact of restrictive measures on the ability of pregnant women to move from their homes to the health facility.

2.2.1 COVID-19 Lockdowns and Impact on Maternal Health Outcomes

The decrease in use of health facilities started in the weeks before lockdown, possibly indicating a heightened fear of disease transmission, which might have stopped women from seeking care at health facilities. During lockdown in Nepal, the rate of decrease in the use of health facilities was heightened because the national lockdown halted public transport and restricted movement of people, like in other countries (Ashish et al, Gurung, Kinney, Avinash, Moinuddin, Basnet…Målqvist M, 2020). According to Ashish et al (2020) The increased proportion of admitted women having complications during admission, including preterm birth, during the COVID-19 lockdown period, might suggest that women at high risk of complications are disproportionately attending health facilities or that the number of complicated cases has increased due to delays and other challenges of the lockdown. Institutional childbirth reduced by more than half during lockdown, with increases in institutional stillbirth rate and neonatal mortality, and decreases in quality of care.

Despite low number of cases, and limited direct morbidity and mortality related to COVID-19, health care systems in many southern African countries remain

vulnerable (Clare, Dube, Moyo & Ngwenya, 2020). Some indirect effects are fear of the virus, shortage of resources, disruption of healthcare infrastructure and systems. This presents increased barriers for access to healthcare services and may result in breakdown of routine health programs. Models based on estimates of disruption to routine maternal and child health services predict up to 38.6% increase in maternal deaths per month across 118 countries. Clare et al (2020) asked the question where women are delivering instead, after observing a decline in deliveries at Mpilo Central Hospital during COVID-19 pandemic.

The Kenyan Government, as a mitigation measure to curb COVID-19 transmission, issued a 30-day lock down, banned international flights, closed schools and banned large social gatherings (Oluochi-Aridi, Chelagat, Nyikuri, Onyango, Guzman, Makanga, Miller-Graff & Dowd, 2020). These government directives pose a huge dilemma, as they disrupt access to health services by pregnant women. Even though expectant mothers have been allowed to leave their houses and go to health facilities to access delivery care during emergencies, they faced challenges with transportation to health facilities during the curfew.

In Nepal, institutional birth rates declined by almost 50% and that institutional neonatal mortality increased by more than 200% in selected referral hospitals between January and May 2020 (Jha, Adhikari, Gautam, Tinkari, Mishra & Khatri, 2021). Women and their families feared hospital visits due to the fear of contracting COVID-19 and a fear of stigma after discharge from those hospitals, hence, the study found a large decline in the use of maternal and neonatal health services during the period of 5 months. Jha et al (2021) recommended that providing quality maternal

and neonatal health services while strictly following procedures to reduce COVID-19 would be the best approach in this scenario. Goyal, Singh, Singh and Shekha (2020) assessed the effect of the COVID-19 pandemic on obstetric care and maternal health outcomes. Focusing on the number of admissions, institutional deliveries, and complications, they found that there was a reduction of 45.1% in institutional deliveries.

2.2.2 The Three Delays Model

Thaddeus et al (1994) developed the Three Delays Model for delays pregnant women experience focusing on the decision to seek care, reaching a health facility, and the provision of adequate care at a health facility. Hence, expanding the coverage of existing referral networks, improving community recognition of obstetric emergencies, and improving the ability of existing medical institutions to deliver quality obstetric care, are all necessary (Barnes-Josiah, Myntti & Augustin, 1998). The WHO conceptual framework of the Three Delays Model demonstrating emergency critical time points is as in Figure 4.

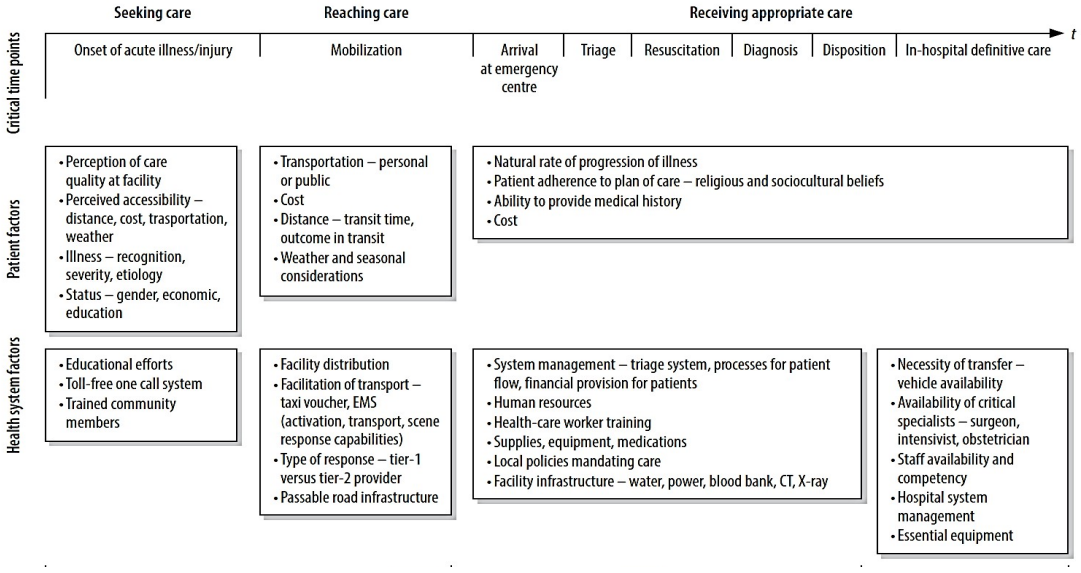

Figure 4. The WHO Conceptual framework for critical time points in emergency care (WHO, 2021)

With regards to the second delay, Reaching Care, the delay occurs in identifying and reaching a medical facility. This is contingent on the planning and organization of pre-hospital emergency services in the setting involved. If care delays are to be minimized, the individuals who provide prehospital services need to be able to identify the level of care that a patient requires and to take the patient directly to the nearest facility that offers that level of care (WHO, 2021). Reaching an appropriate source of care depends on the distance, availability of transport, transport costs, time and opportunity costs and security concerns. The possible interventions are bringing appropriate care closer to community, facilitated referrals, mobilize, provide transport, and funds to cover or minimize costs. The COVID-19 lockdown and movement restriction has caused difficulty for many pregnant women in reaching

health care facilities, in Zimbabwe, with pregnant women facing problems in seeking care (Pant et al, 2020). Decreasing access and utilization of maternal health services can have dire consequences for both the women and newborns.

Mgawadere, Unkels, Kazembe and van den Broek (2017) observed that more than half of all women who died at a healthcare facility (52.1%) had experienced more than one type of delay with type 3 delays being the most significant delay for women who died at a healthcare facility. Major causes of type 2 delays revolved around availability of transport, whilst type 3 delays were attributable to long waiting hours before receiving treatment at a healthcare facility. Chavane, Bailey, Loquiha, Dgedge, Aerts & Temmerman (2018), in Mozambique, used statistical models to assess the association between type 2 delay and type 3 delay to the cause of maternal death within the health facility. They concluded that the delays in reaching and receiving appropriate facility-based care for women facing pregnancy related complications contribute significantly to maternal mortality. The increase in preterm birth could also be associated with the distress of COVID-19-related social restrictions, considering psychosocial stress during pregnancy (Ashish et al, 2020). USAID (2015) summarized The Three Delays Model in Table 1 as follows:

Table 1 USAID (2015) The Determinants of the Three Delays

First delay: **Recognition of danger signs and deciding to seek care**	**Second delay:** **Reaching an appropriate source of care**	**Third delay:** **Receiving adequate and appropriate treatment**
Low educational levels	Distance to source of care	Lack of equipment and supplies
Lack of knowledge and poor recognition of danger signs	Lack of transport	Insufficient staff
Limited birth preparedness knowledge	Financial costs	Lack of trained staff
Decision-making processes	Other time and opportunity barriers	Poor staff attitudes

Actis Danna, Bedwell, Wakasiaka & Lavender (2020) gave a critique of the Three Delays Model, because of its one-dimensionality and its limited utility in triggering preventative interventions.

2.2.3 Pregnancy-Risks that require emergency healthcare access

Selected pregnancy-risks are reviewed in literature to demonstrate that if pregnancy complications are not managed during a national lockdown it can increase maternal morbidity and mortality. To obstetrics providers, risk factor identification in the antenatal and intrapartum periods might enable timely interventions to prevent these complications. Retained placenta after vaginal delivery is diagnosed when a placenta does not spontaneously deliver within a designated amount of time, variably defined as a period of 18–60 mins (Perlman & Carusi, 2019). It may also be diagnosed if a patient experiences significant hemorrhage prior to delivery of the placenta. Risk factors for retained placenta include history of a prior retained placenta, high parity,

uterine surgery, and congenital uterine anomalies. According to Favilli et al (2021), retained placenta affects 0.5–3% of all vaginal deliveries and is considered one of the major causes of primary and secondary postpartum hemorrhage, increasing maternal morbidity and mortality risk. Removal of the retained placenta is associated with several complications such as infections and trauma of the urogenital tract. The risk factors for are a previous retained placenta, older maternal age and prolonged use of oxytocin. Postpartum hemorrhage (PPH) remains a leading cause of maternal death. The risk factors for PPH are fetal macrosomia (over 4000 g), pregnancy-induced hypertension, pregnancy generated by assisted reproductive technology, severe vaginal or perineal lacerations, and weight gain over 15 kg during pregnancy (Fukami et al, 2019).

Women in low- and middle-income countries are at increased risk of anemia in pregnancy, defined as a hemoglobin concentration (Hb) < 110 g/L, because of the higher frequency of dietary iron deficiency (Daru et al, 2018). Anemia has been associated with increased prevalence of ante-partum and post-partum hemorrhage. Daru et al (2018) highlighted strategies to prevent anemia in pregnancy as iron and folate supplementation to pregnant women. Boujenah et al (2017) studied the clinical and bacterial characteristic of Bartholin gland abscesses during pregnancy and the obstetric and neonatal outcomes. They found that although bacterial characteristics did not differ between pregnant and non-pregnant women, pregnancy could increase the occurrence of Bartholin gland abscesses in patients with previous surgical treatment of abscesses. Although pregnancy is known to decrease maternal immune system, the pathogenesis of severe infection after Bartholin gland abscesses

could be related to other conditions, such as concomitant placental abruption , unusual bacteria with a propensity to cause tissue abscesses and cellulitis (Boujenah et al, 2017).

Preeclampsia is known to be a leading cause of morbidity and mortality among mothers and their infants. Approximately 3–8% of all pregnancies in the US are complicated by preeclampsia and another 5–7% by hypertensive symptoms (Nomura et al, 2017). According to MoHCC (2015), the leading causes of maternal deaths, in Zimbabwe, occur 63% in the postpartum, 24% in the antenatal and 6.6% in the intrapartum periods. The maternal deaths were attributed as follows hemorrhage (34%), pregnancy induced hypertension (19%), unsafe abortion (9%), sepsis (9%), indirect causes including AIDS defining conditions and malaria (18%), and other direct causes (11%). The COVID 19 pandemic represents a major stress factor for non-infected pregnant women according to Kirchengast, and Hartmann (2021). Although maternal stress during pregnancy increases the risk of preterm birth and intrauterine growth restriction, an increasing number of studies yielded no negative effects of COVID 19 lockdowns on pregnancy outcome. Ranjbar et al (2021) observed a decrease in preterm births and low birth weight, no change in stillbirths, and a rise in the admission rates of mothers to the ICU during the initial Covid-19 lockdown period compared to pre-Covid-19 lockdown period.

Ko et al (2021) in their study on adverse pregnancy outcomes during COVID-19 found that while the absolute risk of maternal complications and severe illness was low, individuals with a documented COVID-19 diagnosis at delivery hospitalization had 17 times the risk for death, almost 14 times the risk for sepsis, 13 times the risk

for mechanical ventilation, 5 times the risk for shock, 4 times the risk for acute renal failure, and more than twice the risk for adverse cardiac event or thromboembolic disease compared with those who did not have a COVID-19 diagnosis. The COVID-19 lockdown measures were associated with a slightly shorter gestational length and a moderately higher risk of pre-term baby as early and middle pregnancy periods may be a more susceptible exposure window (Dong et al, 2021).

The most common and significant neonatal complication clearly associated with gestational diabetes is macrosomia or an oversized baby with a birth weight greater than the 90th percentile for gestational age and sex, or a birth weight >2 SD above the normal mean birth weight (Jovanovic, 2001). If fetal macrosomia associated with maternal diabetes, it is directly related to maternal glucose levels, then strategies to prevent hyperglycemia must be devised to treat the diabetic pregnant woman. It was mentioned by Yang et al (2004) that vaginal bleeding complicates up to a quarter of all pregnancies and in their meta-analysis found that vaginal bleeding is associated with a twofold increased risk. Although some studies considered heaviness, recurrence, and trimester of bleeding, none considered the effects of bleeding duration and amount. About half of the bleeding episodes during pregnancy have unknown causes and, thus, the reason that vaginal bleeding predicts preterm birth is unclear. Vaginal bleeding and consequent thrombin generation lead to a proteolytic cascade capable of damaging the fetal membranes, which could result in preterm premature rupture of the membranes.

Despite the relative ease with which breech presentation can be identified through ultrasound screening, the assessment of fetal presentation at term is often based on

clinical examination only. Due to limitations in this approach, many women present in labour with an undiagnosed breech presentation, with increased risk of fetal morbidity and mortality (Wastlund *et al*, 2019). 'Born before arrival' refers to childbirth which occurs without a skilled birth attendant and that occurs either at home or on the way to a delivery center or hospital (Phiri, Fylkesnes, Ruano and Molad, 2014). It is assumed that such deliveries happen elsewhere due to delays in seeking or accessing health facility care. According to King, Duthie, To and Ma (1992) this can result in lacerations to the genital tract, postnatal anemia and blood transfusions were more common in the study group.

It was highlighted by West, Warren and Cutts (1992) that irritable bowel syndrome, constipation, and diarrhea may complicate a pregnancy. Although complaints of irritable bowel syndrome and constipation may be managed by nonpharmaceutical methods, a careful history should be conducted to determine whether these complaints are of an acute or a long-standing nature. Birth asphyxia is defined as failure of the newborn to initiate and sustain breathing at birth or an Apgar score of less than 7 at 1 minute (Avebare et al, 2021). Birth asphyxia occurs due to interruption of placental blood flow leading to fetal hypoxia and acidosis. This may manifest with abnormalities in the fetal heart rate also known as fetal distress. In the first days of life, birth asphyxia, may lead to generalized organ damage such as acute kidney injury while long term complications may include infant neurological disorders or cognitive impairment.

Gestational diabetes, the most common medical disorder in pregnancy, is defined as glucose intolerance resulting in hyperglycemia that begins or is first diagnosed in

pregnancy (Saravanan et al, 2020). Gestational diabetes is associated with increased pregnancy complications and long-term metabolic risks for the woman and the offspring. Twin pregnancies are high-risk and associated with increased perinatal morbidity and mortality. According to Murray, Stock, Cowan, Cooper and Norman (2018) multiple pregnancy is associated with adverse maternal outcomes including increased rates of pre-eclampsia, pregnancy-induced hypertension, maternal anemia and venous thromboembolism. Compared to singleton newborns, newborn infants of twin pregnancies are also at increased risk of adverse outcomes including congenital anomalies, cerebral palsy, intrauterine growth restriction and stillbirth.

Hypertensive disorders of pregnancy, chronic hypertension, gestational hypertension, and preeclampsia are uniquely challenging as the pathology and its therapeutic management simultaneously affect mother and fetus, sometimes putting their well-being at odds with each other (Rana, Lemoine, Granger and Karumanchi, 2019). Preeclampsia is one of the most feared complications of pregnancy. Often presenting as new-onset hypertension and proteinuria during the third trimester, preeclampsia can progress rapidly to serious complications, including death of both mother and fetus. While the cause of preeclampsia is still debated, clinical and pathological studies suggest that the placenta is central to the pathogenesis of this syndrome (Rana et al, 2019). According to Assefa et al (2018) the incidence of premature rupture of membranes ranges from about 5% to 10% of all deliveries. A woman with premature rupture of membranes is at risk of intra-amniotic infection, postpartum infection, endometritis, and death. A neonate born from premature rupture of

membranes mother is at high risk of respiratory distress syndrome, sepsis, intraventricular hemorrhage and death.

A prolonged second stage of labour may increase the risk of cervical injury considering that cervical injury is a risk factor to preterm delivery (Quiñones et al, 2018). Caesarean section can be a life-saving intervention for the fetus, the mother, or both in certain circumstances including obstructed labour, distressed fetus, obstetric hemorrhage, abnormal presentation, and other emergency obstetric conditions (Kietpeerakool et al, 2019). As a major surgical procedure, it has short term adverse events to pregnant women (higher rates of hemorrhage, transfusions received, infections, prolonged hospital stays, higher rates of infection in infants, respiratory complications and admission to neonatal intensive care) and long-term obstetric risks in the subsequent pregnancy such as placenta previa, morbidly adherent placenta, and uterine rupture.

Miscarriage is a common outcome of pregnancy, with most studies reporting 12% to 15% loss among recognized pregnancies by 20 weeks of gestation (Magnus, Wilcox, Morken, Weinberg and Håberg, 2019). Quantifying the full burden of miscarriage is challenging because rates of pregnancy loss are high around the time that pregnancies are clinically recognized. Although the cause of most miscarriages is unknown there could be shared underlying risk factors for miscarriage and other adverse pregnancy outcomes. Several studies have looked at the association between the history of miscarriages and the future risk of other pregnancy complications. Urinary tract infection in pregnancy, including asymptomatic bacteriuria, is associated with maternal morbidity and adverse pregnancy outcomes, including

preterm birth and low birthweight (Lee et al, 2020). In low-middle income countries, the capacity for screening and treatment is limited.

Woolner, Ayansina, Black and Bhattacharya (2019) highlighted that third- and fourth-degree tears are injuries which can occur to the perineum during vaginal birth. A third-degree tear extends through the anal sphincter muscle complex. A fourth-degree tear extends into the rectal mucosa. Together they are often known as Obstetric Anal Sphincter Injuries. Both third- and fourth-degree tears can cause distressing symptoms such as fecal incontinence and sexual dysfunction (Woolner et al, 2019). Sepsis is potentially fatal, but literature for the evaluation and treatment of this condition in pregnancy is scarce. In the United States, sepsis is the fourth leading cause of maternal death (Bridwell, Carius, Long, Oliver and Schmitz, 2019).

2.2.4 Telemedicine and application to mitigate the delays to accessing maternal health care during the COVID-19 pandemic

According to Bokolo (2020) medical software applications, as telemedicine, could be used by physicians in outpatients for pregnant women. Telemedicine delivers healthcare digitally, limiting physical human interaction and offers a viable option in the fight against COVID-19. It provides decreased time to get a diagnosis and early initiation of treatment. It is easier to monitor and follow-up patients from their home and to avoid oversaturation of health facilities. This results in the reduction in movement of people, minimizing the risk of intra-hospital infection and supports coordination of medical resources used in distant locations. Outpatients can adopt e-mail, patient portal messages, health apps, electronic consultations (e-consults), telephone, and video conferencing as Google Duo, Zoom, and Microsoft teams.

Other commercially developed products are digital stethoscopes, web cameras, chatbots and wearable devices with mobile sensors. Smartwatches can have thermometers or oxygen monitors (Bokolo, 2020). The factors that impact adoption of telemedicine and virtual software platforms are given in Figure 5.

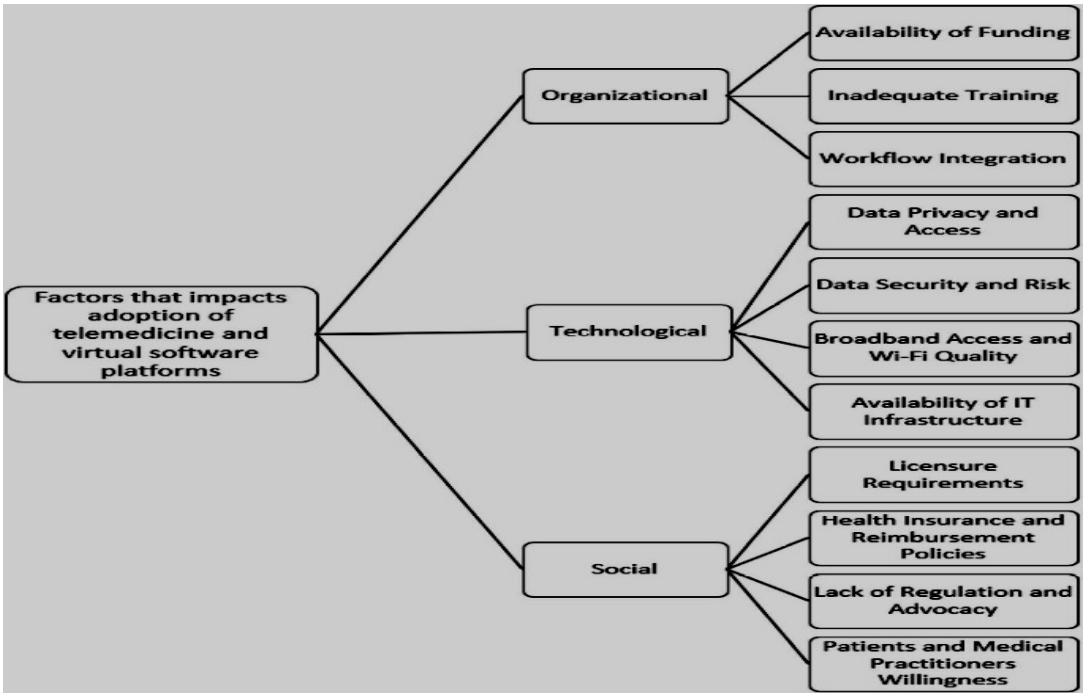

Figure 5. Factors that impact adoption of telemedicine and virtual software platforms (Bokolo, 2020)

KPMG (2020) reiterated telemedicine as a pillar of healthcare resilience. They gave five priority areas for healthcare resilience recovery as digital delivery, an agile workforce, developing new care models, operational resilience, and financial recovery. Digital delivery allows for providing care within the constraints of social distancing and harnessing data to improve delivery. Galle et al (2021) in their study documented the experiences with providing telemedicine for maternal and newborn healthcare during the pandemic among healthcare professionals globally. They found

that some crucial aspects of maternal and newborn healthcare seem difficult to deliver by telemedicine. It was recommended by Galle et al (2021) that more research regarding the effectiveness, efficacy, and quality of telemedicine for maternal healthcare in different contexts is needed before considering long-term adaptations in provision of care away from face-to-face interactions. Clear guidelines for care provision and approaches to minimizing socioeconomic and technological inequalities in access to care are urgently needed.

In another study willingness to adopt telemedicine in the resource-poor settings and hard-to-reach populations, was found to bring relief to the inadequate healthcare systems and alleviate poverty of those who feel the burden of healthcare cost the most (Akintunde et al, 2021). It is expected that with adequate government financing, telemedicine promises to enhance the treating of communicable and non-communicable diseases as well as support health infrastructure. It can also alleviate poverty among vulnerable groups and hard-to-reach communities in Africa with adequate government financing. Akintunde et al (2021) gave a caveat that given the lack of funding in Africa, the challenges in implementing telemedicine require global and national strategies before it can yield promising results. This is especially true regarding alleviating the multidimensionality of poverty in post-COVID-19 Africa.

Maternal-fetal medicine obstetrical patients and providers were highly satisfied with the implementation of telemedicine during the initial wave of the COVID-19 pandemic and most of them desire telemedicine as an option for future visits (Tozour et al, 2021). A patient's desire for future telemedicine visits was significantly affected by their digital experience, the perception of a lack of need for physical

contact, perceived time saved on travel, and access to healthcare providers. Tozour et al (2021) recommend that health systems need to continue to improve healthcare delivery and invest in innovative solutions to conduct physical examinations remotely.

The adoption of telemedicine and telehealth is still nascent in many sub-Saharan Africa countries (Mbunge, Muchemwa and Batani, 2022). As COVID-19 variants spread across Africa, it is becoming clear that responses require action beyond the health sector and must be tailored to the local situation by effectively integrating telehealth and telemedicine solutions in health systems. For instance, virtual wards and telemedicine have been utilized for remote monitoring of patients with COVID-19 to avoid further hospital of patients with mild and manageable symptoms. Mbunge et al (2022) highlighted that telehealth involves the use of technology for remote healthcare and that telemedicine is a subset of telehealth that focuses on the use of electronic information and telecommunication technologies (ICTs) to support and promote long-distance clinical health care. COVID-19 necessitates the use of telehealth and telemedicine solutions to circumvent the challenges associated with in-person care through virtual health care. These technologies provide remote patient monitoring, consultation capture, storage, process and transmission of patient health data, and establish communication between healthcare professionals and patients.

Mbunge et al (2022) recommend that the integration of telemedicine in African health systems can reduce the impacts of the shortage of healthcare professionals and potentially reduce the risk of exposure thereby protecting health workers from COVID-19 infection. Such innovations can substantially improve and ensure easy

delivery of quality health services while limiting regular physical contact and direct hospitalization. However, the adoption of telemedicine and telehealth is still nascent in many sub-Saharan Africa countries as compared to other countries despite their overwhelming benefits in providing virtual healthcare services to vulnerable healthcare systems especially in resource-constrained settings during COVID-19. Interestingly, there is still limited literature on the potential integration of telehealth and telemedicine in sub-Saharan Africa health systems. This study aimed to provide a comprehensive review on the potential and effective integration of telemedicine in sub-Saharan Africa health systems during COVID-19 while introspecting at the implementation barriers. Telehealth especially telemedicine has been the mainstay of patient care by offsetting the decline in outpatient visits, circumventing the spread of COVID-19 and decongesting healthcare facilities during the pandemic while providing critical virtual patient continuity and limiting exposure to healthcare professionals and hospitalization (Mbunge et al, 2022). Telemedicine services include tele-education, teleconsultation, teledermatology, teleradiology, telemonitoring, tele-expertise, telecardiology, teleophthalmology, tele-oncology, and telepsychiatry significantly improve the delivery of healthcare services especially during the pandemic where physical contact is minimal. They further revealed that the integration of telemedicine in health systems is not immune to challenges such as ethical issues, technological, organization barriers, legal and regulatory barriers, cultural barriers, and financial barriers.

Telehealth is an important tool utilized to provide remote clinical care and has increased in prevalence during the coronavirus disease of 2019 (COVID-19)

pandemic. It allows providers to conduct safe, timely, and high-quality ambulatory care for patients without increasing risk of disease exposure for both parties (Dosaj et al, 2021), but in obstetrics and gynecology, practice of telehealth has not been commonplace, and no practical procedural guidelines have been published. Evidence in many areas of medicine shows that care delivered via telehealth results in similar health outcomes to traditional in-person consultations, according to Palmer et al (2021), whose study showed that pregnancy outcomes following the implementation of telehealth in antenatal care seem to be similar to those with conventional in-person care. Davies-Tuck et al (2021) also note that telehealth has seldom been used in antenatal care and recognize that a key limitation of telehealth is the inability to do physical examinations, which are essential in antenatal care for detecting hypertensive disorders of pregnancy and aberrant fetal growth.

According to Chitungo et al (2021) eight sub-Saharan countries successfully utilized telemedicine. The applications were in telepsychiatry to disseminate mental health information and improve access to mental health services, virtual online training program, and teleconsultations. Chitungo et al (2021) mentioned that in a pilot study in Zimbabwe obstetrics and gynecology professionals made use of the social media platform, WhatsApp, to consult and process urgent referrals of expectant mothers, albeit with digital barriers, such as connectivity, data cost, inaccessibility of smartphones, non-delivery on short messaging services. The challenges noted for the implementation of telemedicine are insufficient technological infrastructure and medical equipment, poorly distributed health facilities and services, inadequate

human resources, and training, lack of mobile health frameworks and policies, financial, digital illiteracy, and cultural aspects.

Chitungo et al (2021) recommend that there is urgent need for reform and promulgation of e-health policies, mobile health frameworks, and guidelines centered on ethical values, grounded in privacy and data confidentiality. Concurrently, wider communities support for integration, adoption, and utilization of telemedicine during the pandemic and beyond to improve the quality of care. Digital education of both healthcare workers and the population will help address and minimize socio-economic and technological inequalities in accessing healthcare services. The policy framework should also address insurance reimbursement for telemedicine services. South Africa quickly modified their policy and regulations at the inception of COVID-19 induced restrictive measures, enabling widespread adoption and utility of telemedicine.

2.3 Zimbabwe Information Communications Technology (ICT) Policy

According to the MoHCC (2018), the Zimbabwean public health sector ICT capacity has been built for the district health information software, electronic patient management system, electronic health record, and laboratory information management system, in support of the Constitution of Zimbabwe Section 76 explicit provision for the right to health care. The ICT infrastructure has improved by the installation of local area networks, and a data center at the ministry level. The concern is the level of maturity, consistency, sustainability, and harmonization of the ICT implementation. Hence, according to MoHCC (20218) the MoHCC put together an ICT Policy Framework, a single integrated framework, that describes the key

principles, infrastructure, resources, technologies, processes, and services that guide the governance, management and provision of information and communication technology services. The high-level challenges experienced were low level of capacity in terms of technology, centralization of the ICT capacity at the national level, lack of information systems integration, state of facilities and infrastructure at sub national and health facilities. The emerging trends and technologies that present challenges to the MoHCC are social media, smart phones and devices, cloud computing and online applications. Most importantly is ICT staff skills development and user training. The situational analysis report done by MoHCC (2018) highlighted the following:

- Using ICT can achieve efficiency in the delivery of health services. It can improve health equity as impoverished communities can access information and communication processes. ICTs are in use in both the public and private practice domains of health.
- Shared IT infrastructure within government will avoid duplication of resources for sites with direct fiber connectivity or taking advantage of existing terrestrial fiber countrywide. The implementation of ICT in healthcare initially did not have a common set of standards and guidelines resulting in duplication of efforts, compromised information security, lack of interoperability making it difficult to deliver health services effectively and efficiently.
- The MoHCC needs standard operating procedures (SOPs) on data security, privacy, and confidentiality.

- Telemedicine needs to be streamlined to support clinicians in providing quality healthcare to patients, and transfer of knowledge to the staff.

2.4 Relevance of the Theoretical Frame to the Study

The literature review on the impact of COVID-19 pandemic restrictive measures provides an insight on the experiences of other countries. The theoretical frame looks at the COVID-19 pandemic lockdown measures taken from various sources and countries. It then looks at the model for accessing maternal healthcare timely, the 3 Delays Model and builds the interventions for ensuring timely delivery of service. The literature looks at the complications experienced in pregnancy with an objective of showing how life-threatening the conditions are. The literature around telehealth and telemedicine is reviewed to find new insights on the new ways of health delivery and if there is a possibility of using it and recommending it. The areas of research covered the impact of restrictive measures on maternal health outcomes and hence provided a comparison point with the experiences in Zimbabwe. The contributions on the 2nd Delay of the Three Delays Model, Reaching Care, provided perspectives on why pregnant women in other countries were failing to access maternal healthcare. The relevance of reviewing pregnancy complications from literature was to demonstrate that these can be managed if pregnant women can access antenatal services, are monitored and followed up. The telemedicine literature is relevant because the alternative of regular in-person visits to maternal services delivered at health facilities is the virtual environment, highlighting feasibility, cost-effectiveness and availability to marginalized pregnant women.

2.5 Summary

The literature review started with the theoretical conceptual framework on which the study is premised. The dimensions of the study reflected in the literature are the 3 Delays Model, pregnancy complications and telehealth/telemedicine. These thematic areas provide the lens to see the capacity of the Zimbabwean maternal health services to cope when challenged with a natural disaster or a global level pandemic. The 2nd Delay of the Three Delays model, Reaching Care, cuts a small slice of the whole maternal services cascade. It is pertinent as it represents the movement from home to maternal health service center. The pregnancy complications are reviewed with the objective of highlighting how life-threatening these conditions can be. The literature on application of telemedicine in maternal healthcare highlights practices in other countries and theoretical frameworks of how it can be applied in similar resource settings. A review is done of the status of ICT in the Zimbabwe public health domain. The relevance of highlighting the current local context is to show the level of uptake of telehealth and telemedicine in Zimbabwe and to recommend opportunities or future interventions when natural disasters at the proportion of the COVIDS-19 pandemic occur and impact maternal healthcare.

CHAPTER 3 METHODOLOGY

3.1 Introduction

The research design was chosen considering that the research under COVID-19 guidelines discouraged meeting patients or healthcare workers in favor of physical distancing objectives. There was restriction on movement and hence the study was confined to a single center, the MNMH. The population of choice, sampling methods and data collections were done in the most convenient way considering the circumstances and ethical considerations. The data collection and analysis were done using MS Excel, the sample size and Odds Ratio calculation was conducted using EpiInfo. The descriptive and analytical statistics are presented in frequency tables and graphs. An alpha level of .05 was used for all statistical tests.

3.2 The Research Design

The study was conducted at the Mbuya Nehanda Maternity Hospital. The research used a mixed-methods study research design which comprised of quantitative and qualitative methods (Goyal *et al*, 2021), that included all pregnant women data for the pre-COVID-19 twelve-month period (March 2019 to February 2020) which was compared to a during COVID-19 twelve-month period (March 2020 to February 2021). The variables are ANC visits, admissions for delivery (booked and referrals), pregnancy complications and maternal deaths. The mixed-methods approach was chosen to permit a more complete and utilization of data than do separate quantitative and qualitative data collection and analysis (Wisdom & Creswell, 2013). The advantages of using mixed methods, according to Wisdom *et al* (2013), are

collecting and analyzing both quantitative (closed-ended) and qualitative (open-ended) data. It uses rigorous procedures in collecting and analyzing data appropriate sample size for quantitative and qualitative analysis. This helps in integrating the data during data collection, analysis, and discussion.

A cross-sectional survey was done of the healthcare workers using a questionnaire as in Appendix 1. The questionnaire is semi-structured with consistent set of questions seeking and limited response categories combined with semi-structure to provide more breadth and depth as per healthcare worker experiences. The administration of the questionnaire to healthcare workers was to probe for more insights than what was available and recorded in patient registers.

The study examined the impact of COVID-19 lockdown control measures on the ability of pregnant women to access antenatal services, trend in admissions for delivery and maternal deaths. The second delay of the Three Delays Model, Seeking Care, was the focus. The research hypothesis is that maternal morbidity and mortality increased because of COVID-19 lockdown restrictive measures. The approach was to assess ANC visits, admissions and referrals for pregnant women presenting to MNMH pre- (March 2019 - February 2020) and during COVID-19 pandemic (March 2020 – February 2021), pregnancy complications and maternal deaths.

3.3 Population and Sampling

The MNMH was the preferred and convenient study setting, considering the national guidelines on researching during COVID-19 pandemic. Other considerations for a

single-center study were time constraints for a larger study, proximity to the researcher since there were travel restrictions nationwide. The advantage of MNMH is that it is a tertiary maternity hospital, with high volumes of pregnant women seeking antenatal care and delivery healthcare services. It is a referral center for obstetric complications.

The population was all pregnant women who presented at the ANC clinic and those who were admitted for delivery from March 2019 to February 2021. The sample for analysis of obstetric complications was calculated from the total of pregnant women in each year using EpiInfo calculator. The participant selection was done using systematic random sampling using interval sampling, a form of random sampling in which participants were selected at uniformly separated points.

For the healthcare workers questionnaire administration, the population was all skilled staff working the two years of study. The sample was calculated using EpiInfo and a response rate calculated for the questionnaires turned in.

3.4 Data Collection Instruments

The data for ANC visits from March 2019 to February 2021 was collected from MNMH ANC registers. The admissions to MNMH data were extracted from MoHCC Hospital Statistics HS3/5 Monthly Return Forms. All data was captured onto MS Excel spreadsheets. A semi-structured questionnaire, Appendix 1, was used to probe for doctors' and nurses' observations.

3.5 Data Collection Procedure

All pregnant women who presented for ANC during March 2019 and February 2021 were included in the study to compare trend in ANC visits during the two years. The data was collected from ANC registers with each month's tally. Monthly admission data was obtained, for the March 2019 and February 2021 period, from MoHCC Hospital Statistics HS3/5 Monthly Return Forms and Admissions registers. All data was captured onto MS Excel worksheets. The descriptive and analytical statistics are presented in frequency tables and graphs, and categorical variables as numbers and percentages. The Student *t*-test was used to compare the data from the two time periods, $p<0.05$ was considered statistically significant.

To compare the likelihood of presenting with a pregnancy-risk because of the COVID-19 lockdown, a sample size was calculated using Epi Info statistical calculator, for both comparison years. A random selection of the participants was done using interval sampling. The participants with pregnancy risks in the sample were counted. The Epi Info statistical calculator was used to calculate the number of healthcare workers (doctors and nurses) to administer the questionnaire to. The questionnaire was provided to respondents in compliance with COVID-19 infection prevention protocols.

3.6 Analysis and Organization of Data

The data was organized in MS Excel worksheets as tables for ease of analysis. The descriptive statistics and the t-tests were calculated using MS Excel Data Analysis functionality. The ANC visits, admissions data, maternal deaths, and feedback from

the qualitative survey frequency tables and graphs were generated from the MS Excel Data Analysis Power Pivot. The EpiInfo statistical calculator was used to determine the Odds Ratio (OR) of presenting with a pregnancy risk when exposed to the COVID-19 pandemic public health measures. Pregnancy complications noted in Admissions Registers and those highlighted by doctors and nurses, are presented as bar charts.

3.7 Ethical Consideration

Clearance to go to MNMH was sought from AUREC. The AUREC clearance letter was used to obtain the Parirenyatwa's Clinical Director authorization to carry out this research. Informed consent was sought for each healthcare worker that participated in the qualitative study. The option was given to refuse, withdraw, or completely reject part or all parts of the study, to disclose name of participant and to sign.

3.8 Summary

The mixed methods research design provided ability to get in-depth information of pre- and during COVID-19 scenarios. The administration of the questionnaire to healthcare workers introspected other insights pertinent to highlighting that the lockdown restrictive measures impacted maternal health care delivery. The data presentation and analysis were done using the MS Excel Data Analysis functionality for quantitative analysis and for presenting graphical presentation.

CHAPTER 4 DATA PRESENTATION, ANALYSIS, AND INTERPRETATION

4.1 Introduction

The descriptive statistics for ANC visits, admissions (referral and direct), complications recorded in maternity registers and maternal deaths is summarized in Table 2. The data presentation and analysis is given for ANC visits, admissions (referral and direct), complications listed in registers and those highlighted by healthcare workers in the questionnaire responses, and maternal mortality. The likelihood of presenting with complications because of exposure to COVID-19 lockdown restrictive measures is assessed. The questionnaire responses provided by healthcare workers using the tool in Appendix 1 are presented in graphs and charts.

Table 2 Summary Statistics

	March 2019 to February 2020			March 2020 to February 2021		
	n	Mean	SD	n	Mean	SD
ANC Visits	2497	208.08	52.50	1061	88.42	87.54
Admissions:						
Direct	931	77.58	106.25	1275	106.25	94.64
Referrals	9939	828.25	636.25	7635	636.25	88.34
Total	10870	905.83	742.50	8910	742.00	95.17
Deaths	30	2.50	2.17	26	2.17	1.99

4.2 Data Presentation and Analysis

4.2.1 ANC Visits

The access to ANC visits was extracted from ANC registers for the 12-month pre-COVID-19 and next 12-month period during the pandemic. Figure 6 shows the trend of ANC visits for the two years, with the lockdown period showing a reduced attendance, with zero patients for April to July.

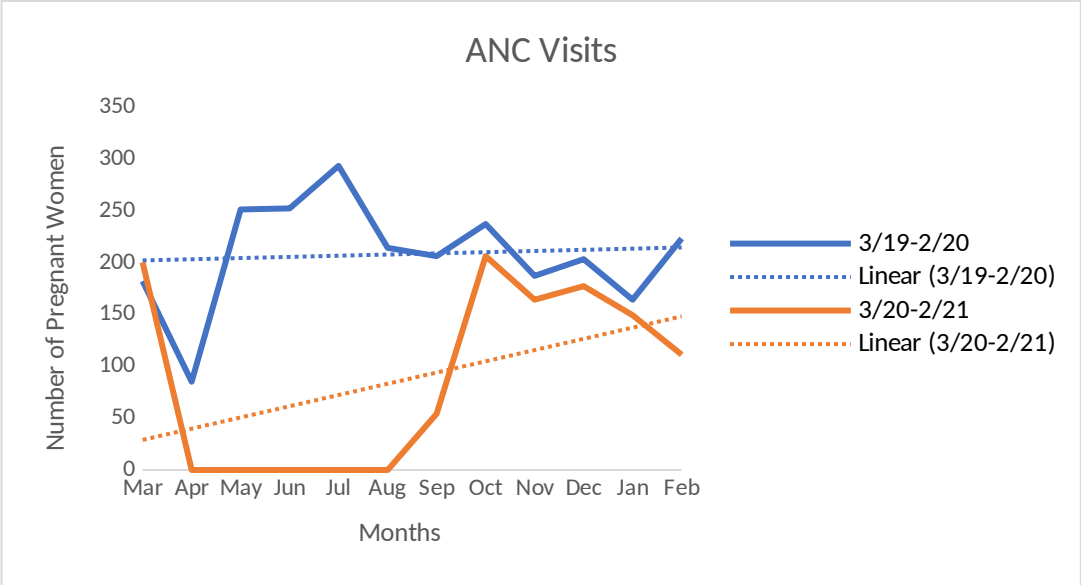

Figure 6 ANC Visits

A comparison of means for the two years using a t-test. We have sufficient statistical evidence, $p<0.001$, that the ANC visits decreased during lockdown, pre-lockdown ($M=208.1$, $SD=52.504$) and during lockdown ($M=88.4$, $SD=9.403$).

4.2.2 Admissions

Figure 7 shows the trends of the total admissions, includes referral admissions and direct admissions. The admissions pre-COVID-19 lockdown show a sharp decline, compared to during COVID-19 that was consistently at same level.

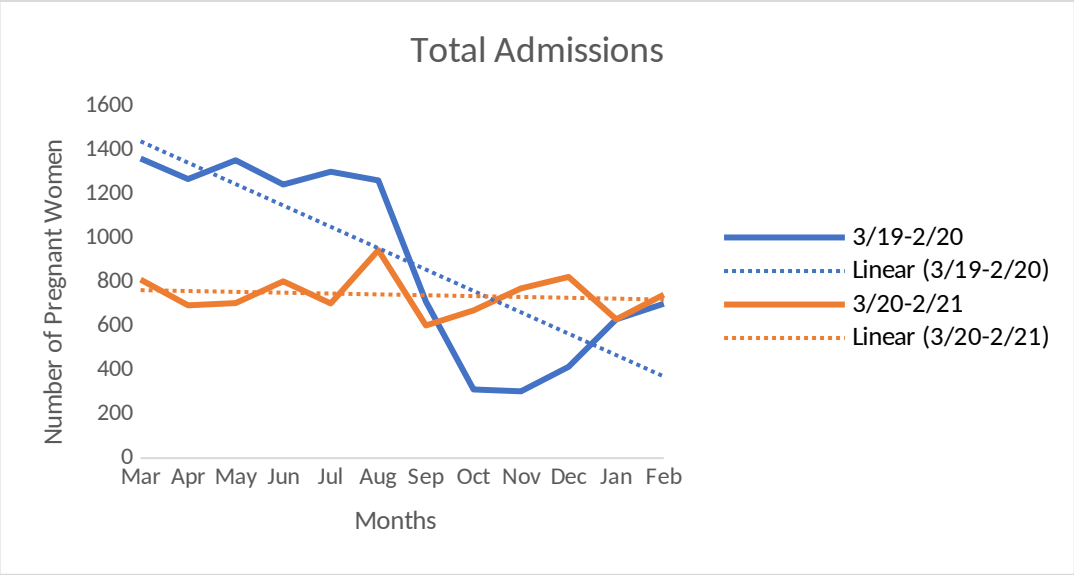

Figure 7. Total Admissions

A comparison of means for the two years was done using a t-test, we have sufficient statistical evidence, p=0.22, that the total admissions are not significantly different during lockdown, pre-lockdown mean (M=905.8, SD=431.710) and during lockdown (M=742.5, SD=95.170).

4.2.3 Referral Admissions

The total admissions are disaggregated into referral admissions and direct admissions. The referral admissions are those from other maternal health centers that do not have specialist doctors, operating theaters, or other higher level maternal healthcare. The direct admissions are pregnant women who present to the maternal hospital without a either an antenatal support history with the MNMH or referred by clinics in the catchment area for MNMH. The trends for either are shown in figure 8 and 9. A comparison of means was done using a t-test. We have sufficient statistical evidence, p=0.195, that the referral admissions are not significantly different, pre-lockdown mean (M=828.3, SD=476.770) and during lockdown (M=636.3, SD=88.340).

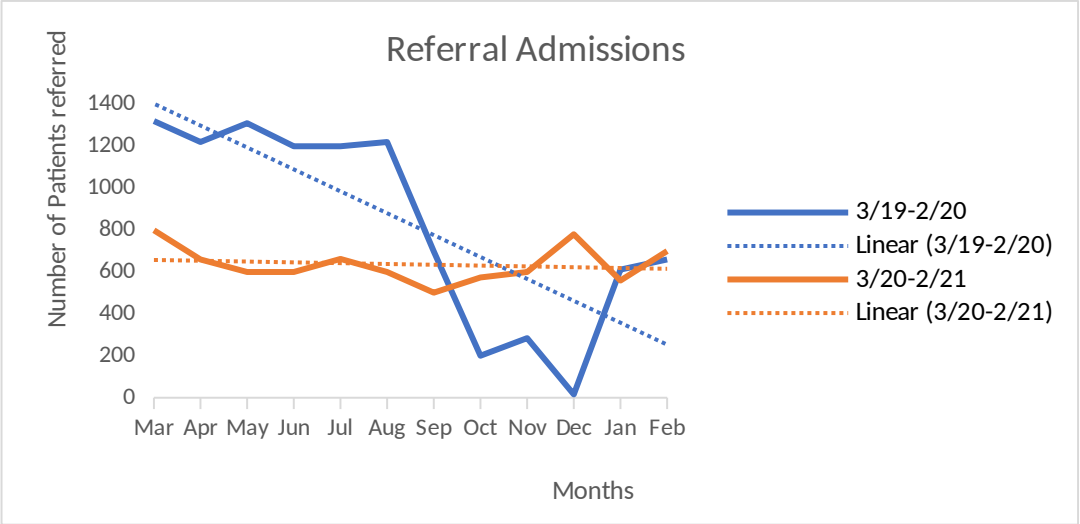

Figure 8 Referral Admissions

4.2.4 Direct Admissions

Figure 9 shows that there were surges in admissions during the lockdown period for June, August, November, and January.

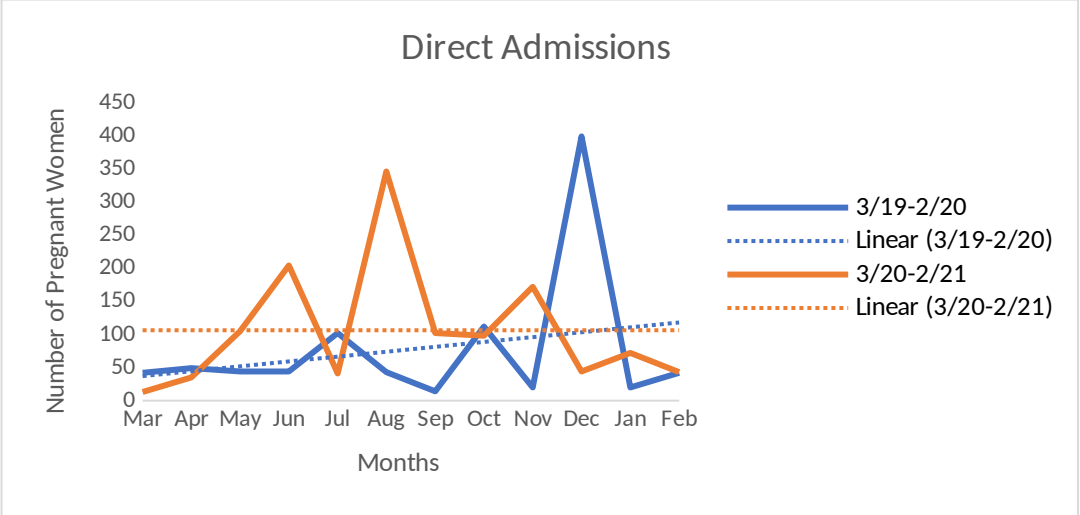

Figure 9 Direct Admissions

Using a t-test (Appendix 5), we have sufficient statistical evidence, $p=0.49$, that the direct admissions are not significantly different during lockdown, pre-lockdown mean *(M=77.58, SD=105.56)* and during lockdown *(M=106.25, SD=94.64)*.

4.2.5 Complications in High-Risk Pregnancies

The complications that pregnant women presented with on admission are as in Figure 10. These complications were recorded by in maternity registers.

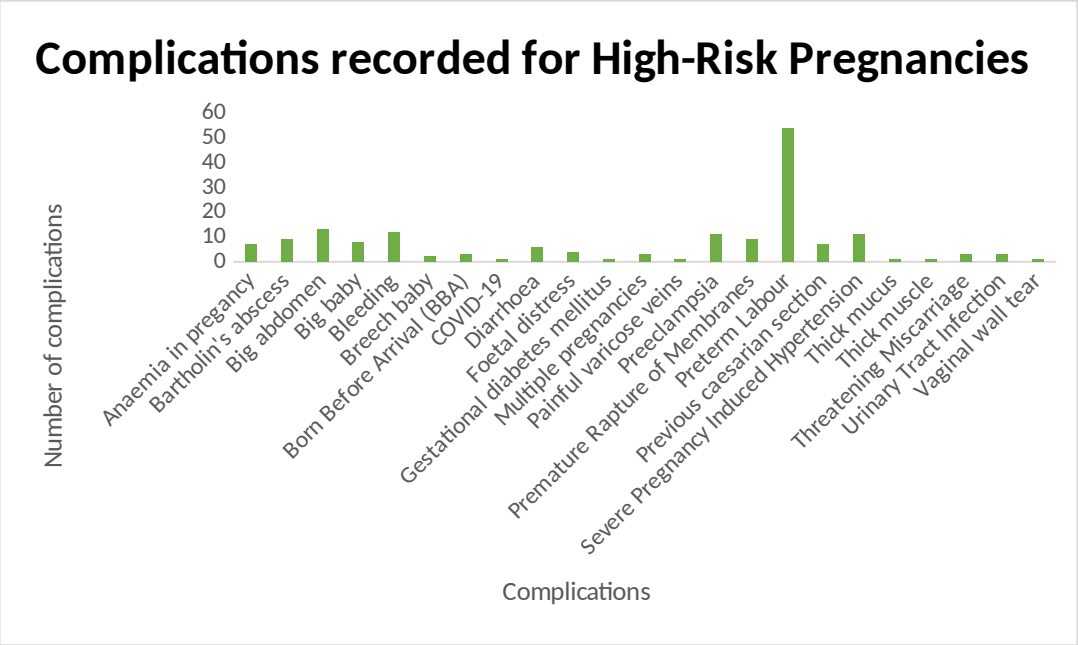

Figure 10 Complications on Admission

Figure 11 shows the complications that were highlighted by doctors and nurses in the survey. The responses were given on the questionnaire, refer to Appendix 1.

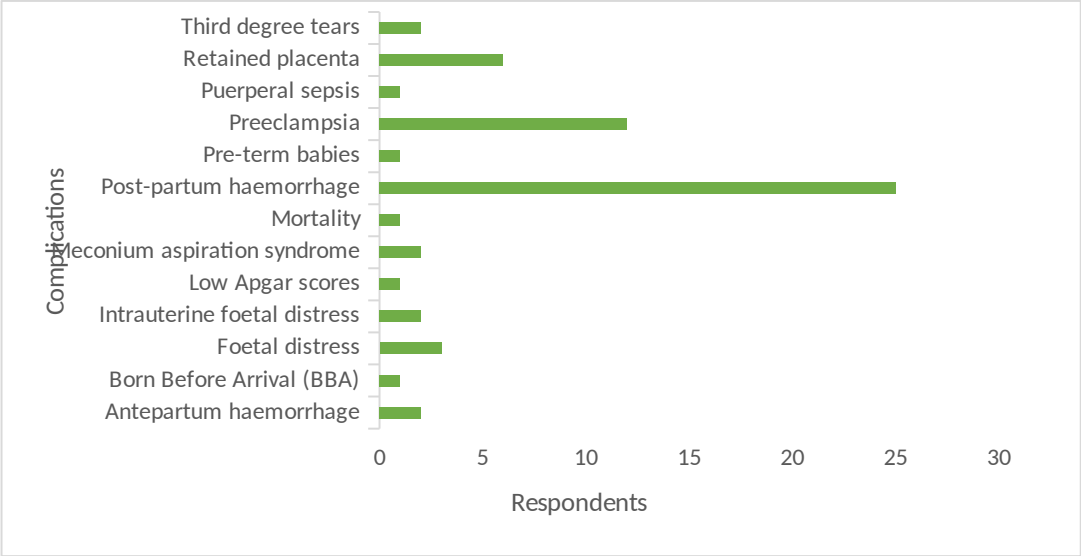

Figure 11 Complications observed by doctors and nurses

4.2.6 The Likelihood of presenting with pregnancy complication when exposed to lockdown

Compared to the pre-COVID-19 period, the odds of presenting with pregnancy complications doubled during the COVID-19 lockdown (OR=2.0; 95% CI: 1.5 - 2.8, p=0.050). The 2x2 table for pregnant women with pregnancy risks pre- and during COVID-19 exposure is as in table 3.

Table 3. 2x2 Table for Exposure to COVID-19 lockdown restrictive measures and Pregnancy Risks

	Pregnancy Risks	No Risks	Total
Exposed to Lockdown (3/2020-2/2021)	171	197	368
Not Exposed (3/2019-2/2020)	111	260	371
Total	282	447	739

4.2.7 Maternal Mortality

The maternal deaths observed for the two years are shown in Figure 12.

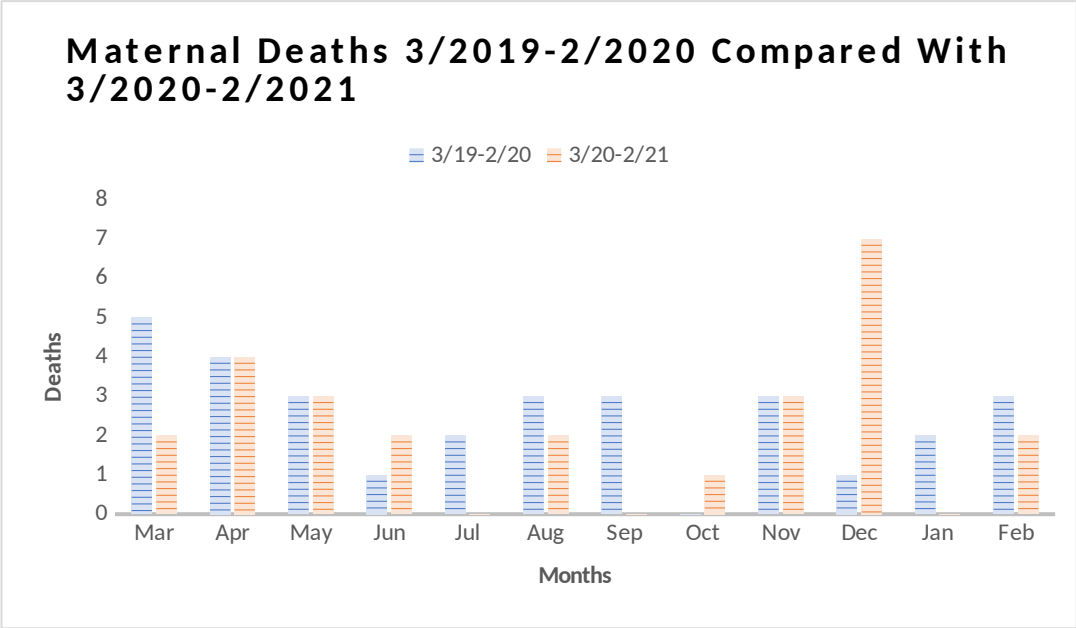

Figure 12 Maternal Deaths pre- and during COVID-19

Using a t-test (Appendix 6), we have sufficient statistical evidence, *p=0.64*, that the maternal deaths are not significantly different during lockdown, pre-lockdown mean *(M=2.50, SD=1.38)* and during lockdown *(M=2.17, SD=1.99)*.

4.2.8 Findings from the Qualitative Survey of Doctors and Nurses

The total doctors and nurses staff compliment at Mbuya Nehanda Maternity Hospital is 65. From the sample size of 56 half (50%) responded. All respondents had worked at MNMH for the 2 years of this study. There were 22 nurses and 6 doctors in the pool of respondents.

4.2.8.1 Pre-Booking before admission

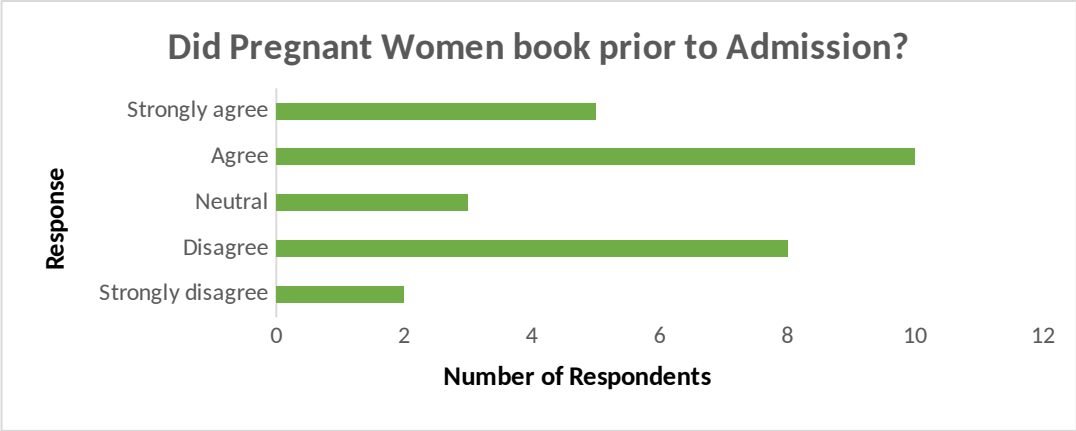

Figure 13 Pre-booking before admission

More doctors and nurses (15/26) agree that a lot of pregnant women presented for admission. during lockdown, without a prior booking.

4.2.8.2 Lack of transportation and delays at roadblocks

Figure 14 shows that more staff agree (12/28) that lockdown roadblocks and delays enroute to MNMH impacted maternal healthcare delivery. However, 8/28 gave a neutral response.

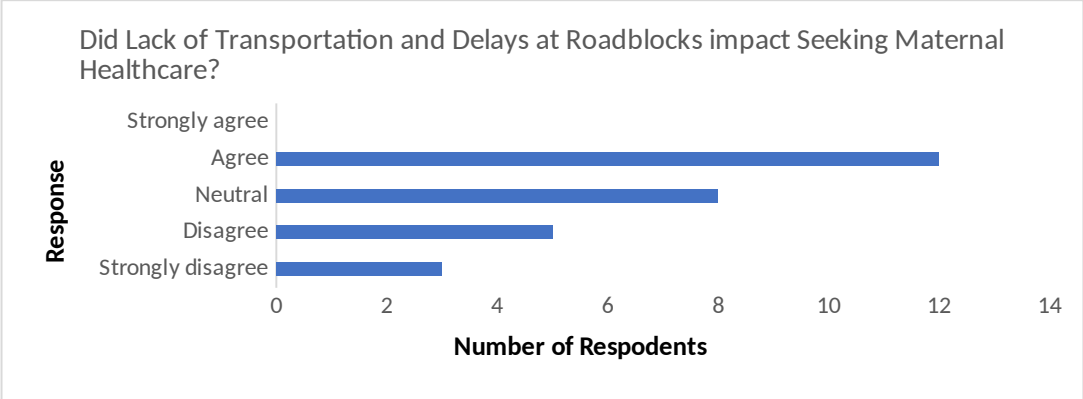

Figure 14 Lack of transportation and delays at roadblocks

4.2.8.3 COVID-19 Anxiety and Stress as a determinant of Pregnancy Complications

More staff disagree (13/28) that COVID-19 induced anxiety and stress contributed to pregnancy-related risks as in Figure 15 below.

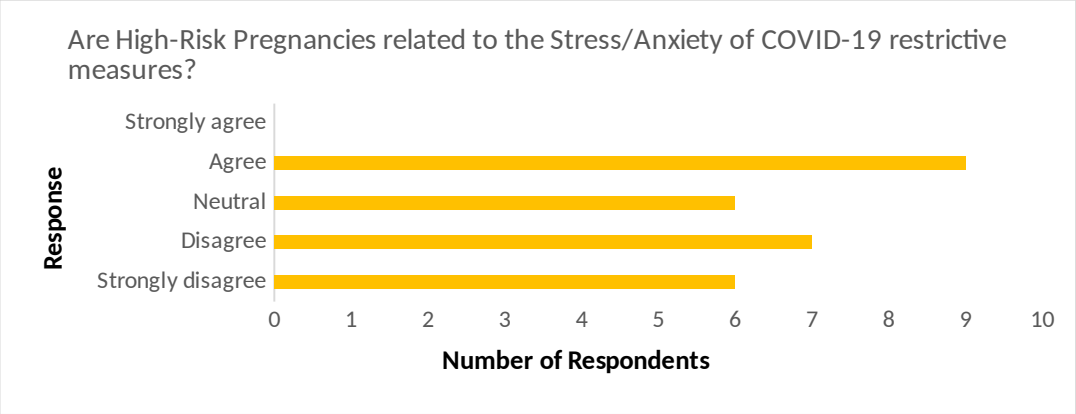

Figure 15 Were Complications caused by COVID-19 anxiety/stress?

4.2.8.4 Main Complications highlighted by Doctors and Nurses

The main complications highlighted by respondents are Post-Partum Hemorrhage, retained placenta, and preeclampsia (see Figure 16 below).

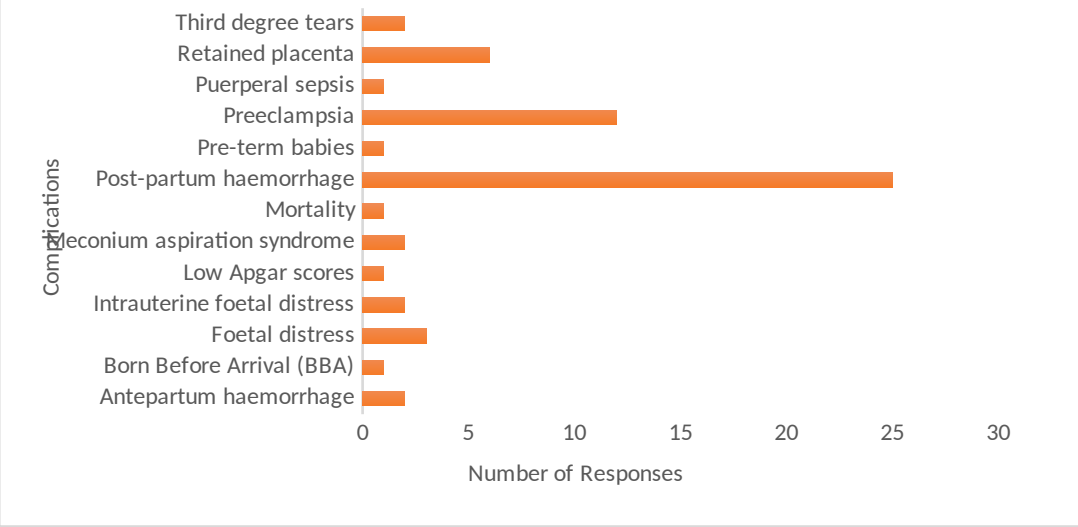

Figure 16 Main Complications highlighted by Respondents to Survey

4.2.8.5 Staffing Levels during the COVID-19 pandemic

In Figure 17 it shows that most respondents, 16/28 disagree that the shifts were adequately staffed.

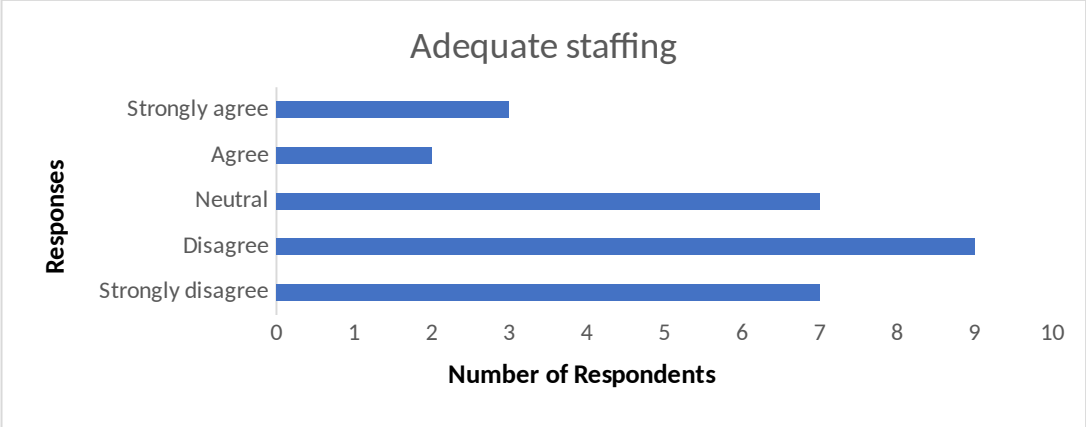

Figure 17 Adequate Staffing during the COVID-19 pandemic

4.2.8.6 Adequate commodities for maternal services

Most respondents, as in Figure 18, disagree (15/28) that there were adequate commodities available for maternal health services during the lockdown.

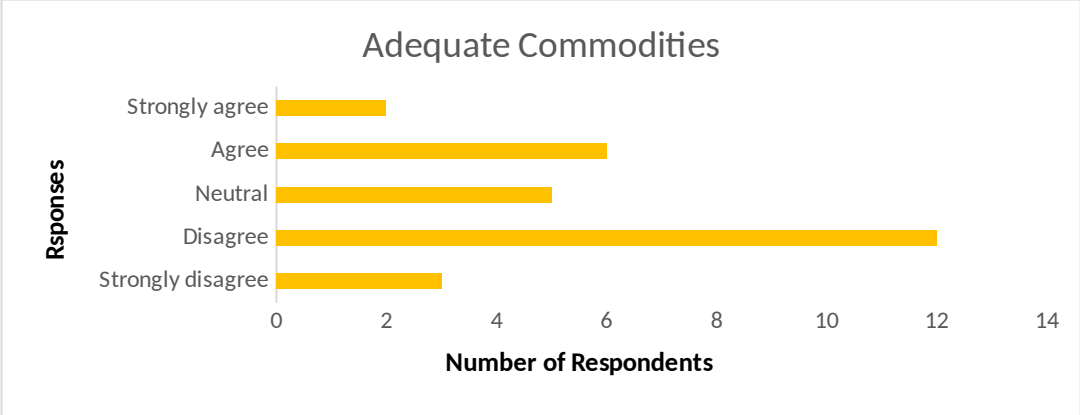

Figure 18 Adequate Commodities during COVID-19 pandemic

4.2.8.7 Other comments from nurses and doctors

The MNMH doctors and nurses also commented that they observed that during the COVID-19 pandemic period there were transport availability or delay problems to health facilities because of the people movement restrictive measures. The restrictions of ANC visits limited the ability to monitor mothers. The roadblocks caused delays for pregnant mothers going to health facilities and resulted in home deliveries or deliveries on the way to a health facility (Born BA. It was highlighted that caesarian procedures increased because of preeclampsia. The facility was overwhelmed with no and late bookings. Reduced number of staff reported for duty due to lack of transportation. The lockdowns affected family's livelihoods and work resulting in lack of money for health access.

4.2.9 Utilization of Mobile Message and Web-Applications

It was observed that although pregnant women's mobile contact phone numbers were recorded in ANC registers, there was no evidence that the women were contacted or followed up for both years. There was no annotation in registers to indicate linkages of pregnant women with complications to high level support. The patient health records, maternity registers and monthly reports are paper based.

4.3 Discussion and Interpretation

There was a decline in ANC visits during the COVID-19 pandemic period. The declaration of COVID-19 pandemic as a natural disaster brought a myriad of restrictive measures including the stay-at-home policy, letters of authorization to leave home or proof of essential work, roadblocks, and punitive fines for

unsanctioned movement. This reduced access to hospitals probably because of lack of transport, or fear of contagion. There was widespread disruption of the healthcare system. The ANC visits at MNMH were severely impacted as pregnant women stayed at their homes. It is noted that there are months when the ANC attendance was zero.

However, there was no significant change in the volumes of admissions to MNMH for delivery. But the pregnant women admitted presented with high-risk pregnancy conditions. The complications doubled because of the reduced ANC visits and pregnancy monitoring. High-risk factors during pregnancy were missed due to delays in lack of access to MNMH maternal health services. From the literature review, PPH, retained placenta, preeclampsia and preterm labor can be prevented by risk profiling during the ANC visits. This allows the physicians to give instructions for admission. There was no surge in maternal mortality because of the COVID–19 lockdown restrictive measures. This is possibly because there was no significant difference in the admissions to delivery wards.

The lockdown affected availability of public transportation for doctors and nurses. This impacted the manning of shifts. It was also highlighted that commodities necessary for maternal healthcare were not readily available. Staff had to use substitutes or had to be creative to be able to deliver service to pregnant mothers.

The MNMH management information system remains manual and paper-based from patient records, ANC registers, admission registers, delivery tracking to monthly statistics reports.

4.4 Summary

The COVID-19 pandemic lockdown and related restrictive measures negatively impacted the ANC visits by pregnant women at MNMH. The pregnant women exposed to the lockdown had a 100% odds ratio of presenting for delivery with a pregnancy risk. There was no significant difference between the volumes of the women admitted pre-pandemic and those during the pandemic. The MNMH IT uptake is very low, and they remain paper-based.

CHAPTER 5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The discussion will cover the findings to provide probable explanation to the outcomes as per research objectives. The focal areas are the impact of the COVID-19 lockdown on the 2nd Delay of the Three Delay Model, obstetric complications comparing the pre- and COVID-19 lockdown periods, likelihood of increased pregnancy-related risks when exposed to the COVID-19 lockdown, trend of maternal mortality comparing pre- and during COVID-19 lockdown, and the MNMH management system and capacity for telehealth, mobile phone communications or virtual platforms. This will be followed by concluding remarks and recommendations. Opportunities for further research on this subject are given at the end of the chapter.

5.2 Discussion

5.2.1 Impact of the COVID-19 lockdown on 2nd Delay of the Three Delay Model

The COVID-19 lockdown restrictive measures impacted pregnant women's ability to reach care timely as demonstrated by the statistically significant decline in antenatal clinic visits (ANC) during the 12 months of exposure to the lockdown. This affected pregnancy monitoring at every trimester, timely referrals and possibly bookings. The guidelines of the lockdown included that ANC facilities be closed for several months, presenting a barrier for pregnant women to access maternal healthcare, monitoring and surveillance. However, the difference in the total admissions of

pregnant women to the delivery ward of MNMH was not statistically significant comparing pre- and during the COVID-19 periods. A disaggregation of the total admissions to admissions due to referrals and direct admissions due to women presenting to facility directly (booked or not booked, emergencies due to pregnancy complications and pregnant women from the catchment area), did not show a significant difference between the two years. It is likely that pregnant women stayed at home during the pregnancy and only presented for delivery at MNMH in droves as other maternity services within the catchment area faced COVID-19 related challenges. Since with regards to the 2nd delay of reaching care, the delay occurs in identifying and reaching a medical facility, it is s contingent on the planning and organization of pre-hospital emergency services in the setting involved.

5.2.2 Obstetric complications comparing pre- and COVID-19 lockdown period

The obstetric complications (PPH, preeclampsia, retained placenta, infections and other highlighted in sections 2.2.3, 4.2.8.3 and 4.2.8.4) are associated with high maternal and neonatal mortality. Since the findings reflect that the 2nd Delay of the Three Delay Model, Seeking Care, was affected by the lockdown restrictive measures, it infers that women with potential to develop these conditions or those that had these conditions manifesting, were denied access to maternal health services. This incapacitated many pregnant women from accessing the critical pregnancy monitoring, identification of pregnancy risks, triage, referral, and follow-up. Hence, for pregnant women with complications, they lived in high risk. The leading causes of maternal morbidity highlighted by the study are preeclampsia,

eclampsia, and hypertensive disorder of pregnancy, PPH, and infections. Reducing maternal morbidity requires pregnancy risk-appropriate care during ANC visits.

5.2.2 Likelihood of increased pregnancy-related risks when exposed to the COVID-19 lockdown

It is observed that the likelihood of increased pregnancy-related risks doubled for pregnant women exposed to the COVID-19 lockdown restrictive measures for pregnant women that were admitted for delivery at MNMH. The only variable investigated in this study is the exposure to COVID-19 restrictive measures. It is probable that the significantly reduced ANC visits was a barrier for pregnant women to decide to seek care and to access care. Hence this impacted ability of skilled practitioners to detect the complications, triage, mitigate or have early for referral to higher level care. Another dimension not fully explored, because of not capturing the pregnant human subjects research, is the impact of mental health (anxiety and stress) on pregnancy complications.

5.2.3 Trend of maternal mortality comparing pre- and during COVID-19 lockdown

In this study maternal mortality did not surge during the 12 months under COVID-19 restrictions, was not significantly different from the period pre-COVID-19. This is possibly a reflection of skill level at MNMH to deal with pregnancy complications considering that the level of complications doubled and that the admissions were from random streams of the catchment area. Since the number admitted for delivery remained significantly constant, it is possible that the causes of mortality did not vary. However, the COVID-19 infection variable was not investigated as during the

period of study COVID-19 testing was not mandatory on admission to MNMH maternal health services. The pregnant patients were co-mingled and no separation of COVID-19 infected and uninfected was done. The predominant test was the rapid-determinant COVID-19 test which was not used in either quarantine or isolation of infected pregnant women. Whilst the COVID-19 infection is a determinant for the maternal deaths it is difficult to quantify as there were no definitive tests as the polymerase chain reaction for the detection of the COVID-19 virus.

5.2.5 The MNMH management system and capacity for telehealth, mobile phone communications or virtual platforms

The MNMH management system is predominantly paper based. Patient records are captured on cards and registers. The patient registers have patient history and any conditions that need monitoring. Although patient contact details are captured in the registers, there was no recording of linkage to higher level care. There was no evidence of mobile phone communications or use of virtual platforms. The MNMH has no telehealth infrastructure. This in contrast to the MoHCC (2018) situational analysis report that highlights the availability of a data center, ICT infrastructure and telehealth capability. The ICT framework shows the potential to transition from the paper-based system to telehealth platforms that can deliver telemedicine to home environments. The IT infrastructure can enable the e-Health hubs to be developed. The e-Health infrastructure can have on premises capabilities for patient-centric requirements, internet or cloud-based resources for the pregnant women's home environment and upscale mobile e-health (m-Health) technology. This has the advantage of health equity as m-Health enables pregnant women to use mobile-

phones or tablets, especially regarding that Zimbabwe has a high cellphone penetration. The cascading benefits are zero paper-based systems, speed of pregnancy health promotion awareness, community mobilization to support reaching care, appointment scheduling, reminders, and mobile telemedicine. The e-Health hub can also build capacity for virtual patient monitoring, health surveys, surveillance of pregnancy-risks, and maternal mortality. Dzinamarira et al (2020) reiterated that the recent surge in COVID-19 cases in Zimbabwe is an urgent national public health concern, and hence the need to assure continuity of maternal healthcare by technological adaptations.

5.3 Conclusions

During a public health emergency, to the scale of the COVID-19 pandemic, a contingency public health national plan must be available for continuity of maternal health services. The model can have innovative ways of reaching pregnant women, especially those with pregnancy-risks. To improve equitable access and quality of health care in Zimbabwe for women, access to comprehensive emergency obstetric care during emergencies need a guiding national policy. To meet high ANC coverage during pandemics or national disasters requires adoption of technology that communicates with the pregnant women is necessary. Using ICT can achieve efficiency, improve health equity as impoverished communities and access information and communication processes. The implementation of ICT in healthcare needs upscaling and finding to ensure that technology transfer is enabled. The MoHCC needs standard operating procedures (SOPs) on data security, privacy, and confidentiality, human resources training and a deliberate and sustained change

management. Telemedicine needs to be streamlined to support clinicians in providing quality healthcare to patients, and transfer of knowledge to the staff. It is important to have a telemedicine clinical interface that simulates the in-person environment except for procedures that require in-person presence. Hence the MoHCC can orient the ICT policy to serve a hybrid environment of care efficiently and effectively, with deliverables for the home and the within facility environments.

The COVID-19 pandemic impacted the 2nd Delay of the Three Delays Model, Reaching Care, as demonstrated by reduction of ANC visits. It also doubled the risk of pregnant women resenting with complications on admission. The level of admissions and maternal deaths remained the same in the pre- and during COVID-19 pandemic periods. This is possibly explained by the fact that the volume of patients admitted for delivery in both years is not statistically significant. It was acknowledged that the MNMH is low on modernization, has no IT infrastructure, ability to short-message pregnant women and relies predominantly on paper-based systems.

The COVID-19 pandemic has challenged healthcare systems worldwide and adaptations to the challenges have included the extensive reorganization of the delivery of maternity care. Widespread disruption of the healthcare system, the stay-at-home policy, and reduced access to hospitals and food have affected maternal outcomes and may continue to have an impact in the future. In this study it has impacted reaching care and doubled the risk of pregnant women presenting with complications. It is possible that there was no surge in maternal deaths as projected and experienced in other countries, because of the level of skill of the healthcare

workers at MNMH. The study has managed to show a glaring gap in the MoHCC inertia in modernizing the health workplace. It is crucial for the health policy to shift towards e-Health and the health budget favor investment in IT infrastructure. The return of investment will be realized through decongesting the out-patients, patient-centric strategies and speed of health service delivery.

5.4 Implications

The reduced access to ANC facilities impacts monitoring of pregnant women and so the early detection of pregnancy risks and triage for care is not done. The increased proportion of admitted women having complications during admission during the COVID-19 lockdown period, implies that the 1st delay, making a decision to seek care, was impacted by circumstances around self-efficacy of pregnant women. It could also imply that the situation around the family structure and the community was not enabling for pregnant women to be able to access healthcare timely. The high number of complications could also imply that the communication and tracking of pregnant women is not effective. Although there were contact mobile phone numbers for each pregnant woman's patient record, there was no evidence of subsequent follow-ups and linkage to higher level care. This implies that capacity must be built to ensure that ensure that there is adequate information gathered for pregnancy life cycle. The introduction of electronic patient records and closer communication with the patient will assist in timely detection of complications. The use of paper-based systems has implications on organizational agility and the ability to render high quality maternal health services.

5.5 Recommendations

A health system focus needs to be adopted with the triage system, processes for patient flow, financial provision for patients, human resources sufficiency (availability of critical specialists, surgeons, intensivists and obstetricians, staff availability and competency), health-care worker training, supplies, equipment, medications, and local policies mandating care. There is an urgent need to prioritize safe, accessible, and equitable maternity care within the strategic response to COVID-19 and in future health crises. To enable delivery of essential health services during the COVID-19 pandemic it requires support and interventions at all stages of the maternal health cascade. As per the conceptual and theoretical framework given in Section 2.2, the investment of effort should be in the home and community environment where pregnant women reside. There must be efforts to improve the socio-economic status of women to empower them to pay for transportation to health facilities. The spouse and family must be adequately informed so that they can facilitate speedy access to care when complications present. The community must have a contingency plan to mobilize transportation under crisis. Most importantly the health facility must build a telehealth infrastructure that has components of a maternal health system at the facility, telemedicine communication hubs and virtual care platforms. This enables a hybrid of care approach for both virtual care and in-person care for higher level care and deliveries. The technological intervention of telehealth will be less expensive that mortar-and-brick antenatal support centers. In emergencies of this nature the government can partner with not-for-profit and private

sector organizations to augment the fiscal provisions and also to have shared innovations.

Digital delivery assists in building capacity for resilience for maternal healthcare by providing care within the constraints of social distancing and harnessing data to improve delivery. It requires accelerated digital e-Health care models, innovation, and transformation. Healthcare workers need training and support to adapt to new digital care models. Patients requiring ambulatory care can utilize tele-health/tele-medicine platforms. An IT hub can be constructed in health facilities with mobile computing capability, short-messages, voicemail, helpline, online applications, and video-calls. Utilization of IT avoids overcrowding and triages pregnant women's risks for the need to visit a health facility. The emergency and critical care services model should include routine high-risk pregnancy monitoring, early detection of complications, referral, follow-up, and prioritize ANCs in the last trimester.

It is recommended that the Ministry of Health and Child Care policy team urgently embark on reform and promulgation of e-health policies, mobile health frameworks, and guidelines centered on ethical values, grounded in privacy and data confidentiality, support for integration, adoption, and utilization of telemedicine during the pandemic and beyond to improve the quality of care. The challenges noted for the implementation of telemedicine are insufficient technological infrastructure and medical equipment, poorly distributed health facilities and services, inadequate human resources, and training, lack of mobile health frameworks and policies, financial, digital illiteracy, and cultural aspects.

5.6 Suggestions for Further Research

The glaring opportunities for further research are in finding the direct impact of COVID-19 virus infection on pregnant women ante-natal, intra-partum, and post-partum. This research can determine if there is immune-suppression with COVID-19 infection that can give rise to pregnancy-related risks. Since there has been screening of COVID-19 prior to care, cohort studies can be done to investigate causality of COVID-19 and pregnancy complications in the COVID-19 positive pregnant cohort compared to the negative. It will be interesting to do a survey of mothers who gave birth during the COVID-19 pandemic to quantify the proportion that had institutional births and the probe the reasons for deliveries outside institutions. This research can be backed by knowledge, attitudes, and practices cross-sectional surveys. A larger scale multi-center study which incorporates rural health facilities, mission, district, provincial and central hospitals will provide more generalizable information on impact of COVID-19 pandemic on morbidity and mortality.

Another opportunity for further research is in IT modelling to find the most efficient and cost-effective telehealth infrastructure. What is pertinent is the design and choice of infrastructure and how it will be embedded in the environment where cheaper phones and gadgets are predominantly in use. This can be done with a view of recommending maternal health systems strengthening and paradigm shift from traditional in-person care. More research regarding the effectiveness, efficacy, and quality of telemedicine for maternal healthcare in different contexts is needed before considering long-term adaptations in provision of care away from face-to-face interactions.

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APPENDICES

Appendix 1: Questionnaire Survey Instrument

Name of Student: Noah Mandoza

Student ID: 170820

Questionnaire to determine the Healthcare Personnel's Experience during the pre- (April 2019-March 2020) and during COVID-19 (April 2020-March 2021) lockdown

Name of Data Collector: _____
Date: _____
Name of Respondent: _____
Informed Consent

The following online research is to determine if there was impact on the delivery of maternal health services at Mbuya Nehanda Maternity Hospital. You are free to voluntarily participate or not. You can choose to answer all or part of the questions. You can also discontinue the responses at any stage of the questionnaire. You can sign or not the acknowledgement of the consent to participate.

Signature of Respondent: _____

(Provide insert your initials if you don't have an electronic signature)

1. **What is your professional title?**

(Please tick as many boxes as apply)

Doctor.....☐1

Nurse.....☐2

Other please specify.....☐3

2. **Did you work in the Mbuya Nehanda Maternity Hospital pre- (April 2019-March 2020) and during COVID-19 (April 2020 – March 2021)?**

(Please tick one box)

Yes.....☐1

No.....☐2

3. **Did you observe any changes in the number of pregnant women admissions from April 2019 to March 2021?**

(Please tick one box)

No.....☐1

Yes.....☐2

4. **Did pregnant women presenting at Mbuya Nehanda Maternity Hospital show signs of depression?**

(Please tick one box)

Strongly disagree.....☐1

Disagree.....☐2

Neutral.....☐3

Agree.....☐4

Strongly Agree.....☐5

5. **Where all pregnant women who presented booked for admission?**

(Please tick one box)

Strongly Agree.....☐1

Agree.....☐2

Neutral.....☐3

Disagree.....☐4

Strongly Disagree.....☐5

6. **Did many pregnant women indicate lack of transportation, delays at road-blocks**

(Please tick one box)

Strongly disagree.....☐1

Disagree.....☐2

Neutral.....☐3

Agree.....☐4

Strongly Disagree.....☐5

7. **Are the complications that pregnant women presented with related to stress/anxiety of the lockdown restrictive measures?**

(Please tick one box)

Strongly disagree.....☐1

Disagree.....☐2

Neutral.....☐3

Agree.....☐4

Strongly Agree.....☐5

8. **Which were the main complications experienced during delivery?**

_____

_____

_____

_____

9. **Were you adequately staffed in your shift?**

(Please tick one box)

Strongly disagree.....☐1

Disagree.....☐2

Neutral.....☐3

Agree.....☐4

Strongly Agree.....☐5

10. **Did you have adequate medical supplies, delivery packs, drugs, personal protective equipment and linen**

(Please tick one box)

Strongly Agree.....☐1

Agree.....☐2

Neutral.....☐3

Disagree.....☐4

Strongly Disagree……..☐5

11. **Please add any comments you would like to make about your experience of impact of the lockdown restrictive measures on pregnant mothers and maternity care.**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Thank you for your feedback

Appendix 2: AUREC Clearance Letter

Investing in Africa's future

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

P.O. Box 1320 Mutare, Zimbabwe, Off Nyanga Road, Old Mutare-Tel (+263-20) 60075/60026/61611 Fax: (+263 20) 61785 website: www.africau.edu

Ref: AU2121/21 16 June, 2021

Noah Mandoza

C/O CHANS

Africa University

Box 1320

Mutare

RE: THE EFFECT OF THE COVID-19 PANDEMIC ON MATERNAL HEALTH OUTCOMES: USE OF THE 3-DELAY MODEL FOR THE COMPARISON OF THE PRE- AND COVID-19 TIMELINES AT MBUYA NEHANDA MATERNITY HOSPITAL, PARIRENYATWA GROUP OF HOSPITALS, HARARE, ZIMBABWE

Thank you for the above titled proposal that you submitted to the Africa University Research Ethics Committee for review. Please be advised that AUREC has reviewed and approved your application to conduct the above research.

The approval is based on the following. a) Research proposal
b) Data collection instruments
c) Informed consent guide

- **APPROVAL NUMBER** AUREC 2121/21

This number should be used on all correspondences, consent forms, and appropriate documents.

- **AUREC MEETING DATE** NA
- **APPROVAL DATE** June 16, 2021
- **EXPIRATION DATE** June 16, 2022
- **TYPE OF MEETING** Expedited

After the expiration date this research may only continue upon renewal. For purposes of renewal, a progress report on a standard AUREC form should be submitted a month before expiration date.

- **SERIOUS ADVERSE EVENTS** All serious problems having to do with subject safety must be reported to AUREC within 3 working days on standard AUREC form.
- **MODIFICATIONS** Prior AUREC approval is required before implementing any changes in the proposal (including changes in the consent documents)
- **TERMINATION OF STUDY** Upon termination of the study a report has to be submitted to AUREC.

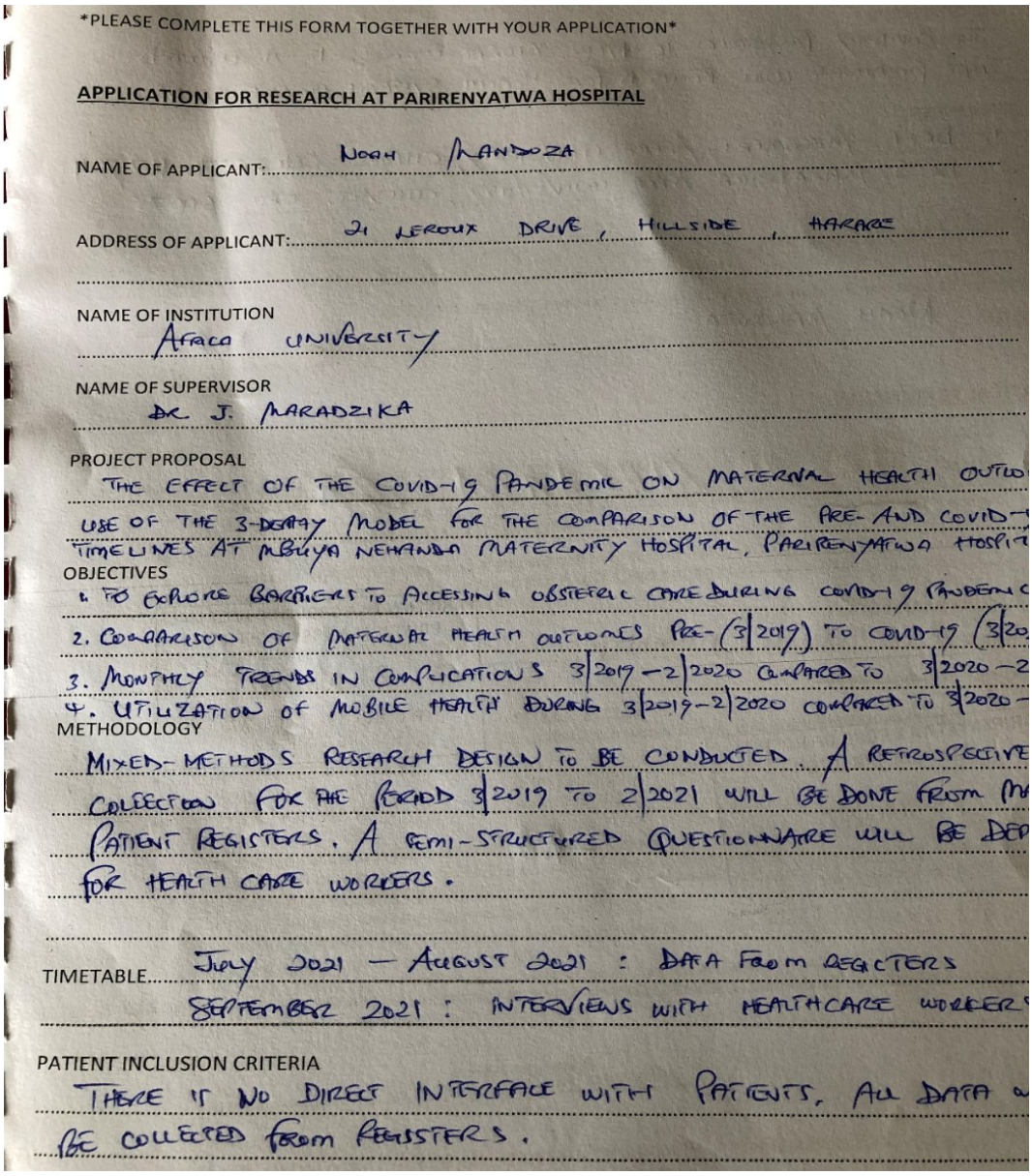
AFRICA UNIVERSITY
RESEARCH ETHICS COMMITTEE (AUREC)

APPROVED
P.O. BOX 1320, MUTARE, ZIMBABWE

Yours Faithfully

MARY CHINZOU – A/AUREC ADMINISTRATORFOR CHAIRPERSON, AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE

Appendix 3: MNMH, Parirenyatwa Group of Hospitals Station Permission



PLEASE COMPLETE THIS FORM TOGETHER WITH YOUR APPLICATION

APPLICATION FOR RESEARCH AT PARIRENYATWA HOSPITAL

NAME OF APPLICANT: NOAH MANDOZA

ADDRESS OF APPLICANT: 21 LEROUX DRIVE, HILLSIDE, HARARE

NAME OF INSTITUTION
AFRICA UNIVERSITY

NAME OF SUPERVISOR
DR J. MARADZIKA

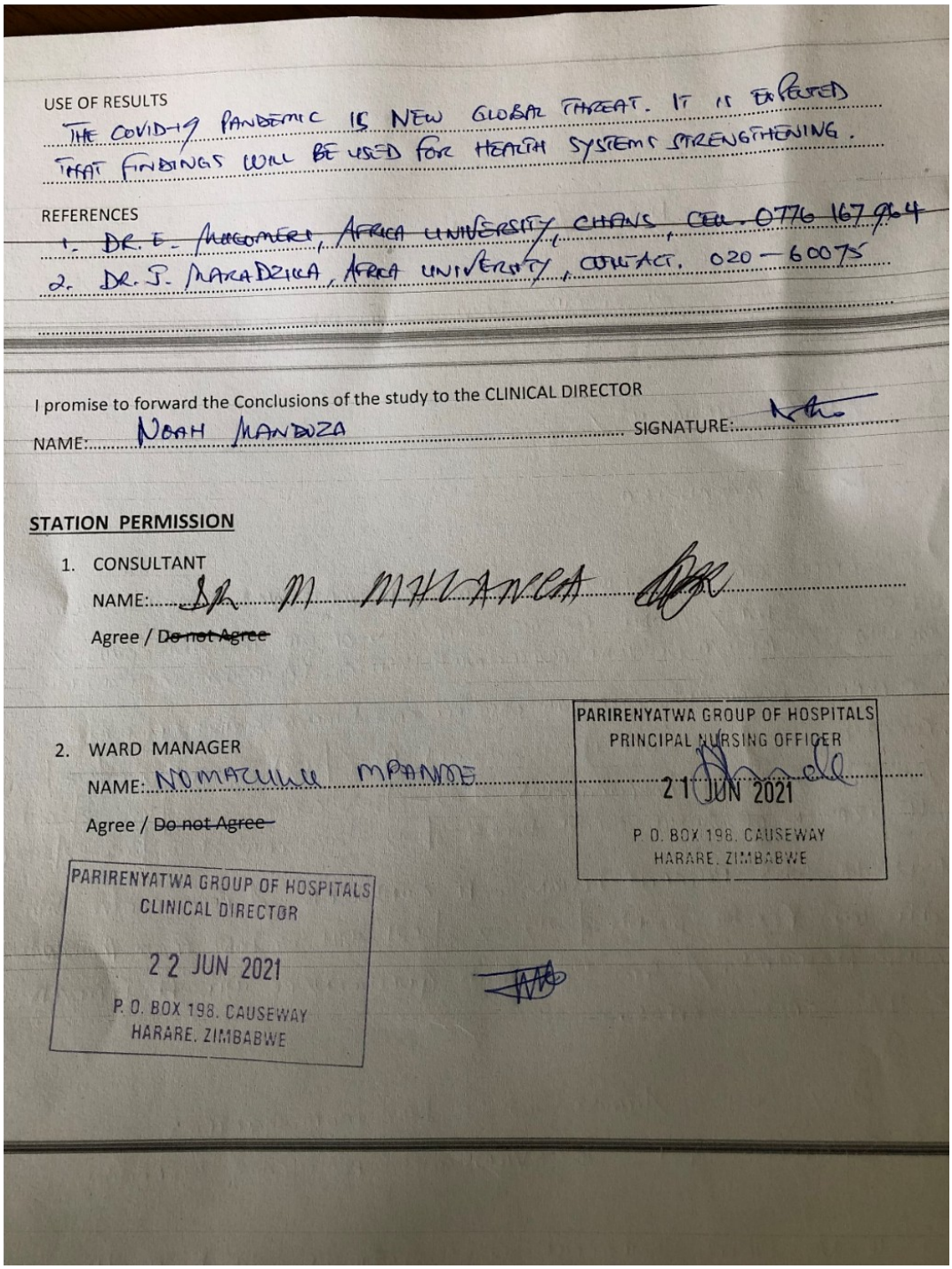
PROJECT PROPOSAL
THE EFFECT OF THE COVID-19 PANDEMIC ON MATERNAL HEALTH OUTCO
USE OF THE 3-DELAY MODEL FOR THE COMPARISON OF THE PRE- AND COVID-
TIMELINES AT MBUYA NEHANDA MATERNITY HOSPITAL, PARIRENYATWA HOSPI

OBJECTIVES
1. TO EXPLORE BARRIERS TO ACCESSING OBSTETRIC CARE DURING COVID-19 PANDEMI
2. COMPARISON OF MATERNAL HEALTH OUTCOMES PRE-(3|2019) TO COVID-19 (3|20
3. MONTHLY TRENDS IN COMPLICATIONS 3|2019–2|2020 COMPARED TO 3|2020–2
4. UTILIZATION OF MOBILE HEALTH DURING 3|2019–2|2020 COMPARED TO 3|2020–

METHODOLOGY
MIXED-METHODS RESEARCH DESIGN TO BE CONDUCTED. A RETROSPECTIVE
COLLECTION FOR THE PERIOD 3|2019 TO 2|2021 WILL BE DONE FROM PA
PATIENT REGISTERS. A SEMI-STRUCTURED QUESTIONNAIRE WILL BE DEP
FOR HEALTH CARE WORKERS.

TIMETABLE: JULY 2021 – AUGUST 2021 : DATA FROM REGISTERS
SEPTEMBER 2021 : INTERVIEWS WITH HEALTHCARE WORKER

PATIENT INCLUSION CRITERIA
THERE IS NO DIRECT INTERFACE WITH PATIENTS, ALL DATA W
BE COLLECTED FROM REGISTERS.



USE OF RESULTS

THE COVID-19 PANDEMIC IS NEW GLOBAL THREAT. IT IS EXPECTED THAT FINDINGS WILL BE USED FOR HEALTH SYSTEMS STRENGTHENING.

REFERENCES

1. DR. E. MUGOMERI, AFRICA UNIVERSITY, CHAINS, CELL 0776 167 964
2. DR. T. MAKADZIKA, AFRICA UNIVERSITY, CONTACT. 020 – 60075

I promise to forward the Conclusions of the study to the CLINICAL DIRECTOR

NAME: NOAH MANDOZA SIGNATURE:

STATION PERMISSION

1. CONSULTANT

   NAME: Dr M MHLANGA

   Agree / ~~Do not Agree~~

2. WARD MANAGER

   NAME: NOMATHEMBA MPANDE

   Agree / ~~Do not Agree~~

PARIRENYATWA GROUP OF HOSPITALS
PRINCIPAL NURSING OFFICER
21 JUN 2021
P. O. BOX 198, CAUSEWAY
HARARE, ZIMBABWE

PARIRENYATWA GROUP OF HOSPITALS
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22 JUN 2021
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