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The uptake of and access to Expanded Programme for Immunization services among children aged 0 to 12 months during the COVID-19 pandemic in Free State Province, South Africa

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RESEARCH REPORT

RESEARCH TOPIC: The uptake of and access to Expanded Programme for Immunization services among children aged 0 to 12 months during the COVID-19 pandemic in Free State Province, South Africa

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand,

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Maternal and Child Health

Declaration

I, Nomvuyiseko Maduna (1911670) declare that the report is my own work and reflects my own efforts. This report is submitted for the fulfilment of my Master in Public Health (Maternal and Child Health) under the Community Paediatrics Department of the School of Public Health in the University of Witwatersrand. This report has not been submitted to any other institution for higher learning for completion of any degree nor has it been submitted to any journal for publication. I have also adhered to all citing and referencing requirements, appropriate acknowledgement of other people's work, ideas and contributions.

Signature: 

Date: 19 October 2024

Dedication

I dedicate this dissertation to all health care managers and implementers who continuously strive for the betterment of health systems for all children to benefit from interventions that avert preventable childhood illnesses and deaths.

ABSTRACT

Introduction

South Africa had the first case of COVID-19 on 5 March 2020 and has since then seen a rapid transition from imported cases to community transmission, increase in rates of infection, which led to restrictions in a number of activities, to reduce the risk of transmission. The provision of EPI services was one of the health programmes that slowed down during the time of the pandemic. The aim of the study was to describe the uptake and access to, and explore the effects of the pandemic disruption on the Expanded Programme for Immunization services among children aged 0 to 12 months during the COVID-19 pandemic, explore the effects in Free State Province, South Africa

Methodology

This is a descriptive exploratory research study, conducted utilising both quantitative and qualitative data was collected and analysed sequentially. The quantitative component was the analysis of data from the DHIS electronic database, disaggregated by district, assessing the differences in EPI services uptake between the periods 12 months before and 12 months after the emergence of COVID-19. The data was analysed using non-parametric tests: Wilcoxon rank sum test and Kruskal Wallis tests.

Sequentially, qualitative data was collected through unstructured key informant interviews conducted, with the provincial and district managers of the EPI and Maternal and Child Health programmes to understand their experiences implementing the EPI programme during the COVID-19 pandemic. The latent thematic analysis was applied to the data collected, following a framework based on the WHO building block of a health system.

Results

The study established that although there were declines in immunization uptake among one-year old children, after the emergence of the COVID-19 were not significant (P-Value >0.005). The qualitative results showed that, although the decline in EPI uptake, COVID-19 increased the demand for health services on the health system, negatively affecting the delivery of PHC services,

generally. The EPI services and access were also significantly challenged. However, the study suggests that the EPI service delivery challenges experienced during the COVID-19 emergency period were not new, but they aggravated the pre-pandemic health system issues that were always slowing down the programme performance. These are issues such as shortage of staff, limited funding, lack of pandemic and emergency preparedness, strategic information and data management capacity gaps and weaknesses in leadership and governance decision making processes and interventions.

Conclusion and recommendations

The emergence of COVID-19 aggravated pre-existing health systems gaps and challenges. To ensure maintenance of services like EPI during pandemics like COVID-19, there is need to address these gaps. We recommend health system investment in emergency and pandemic preparedness and readiness, more robust EPI marketing, advanced strategic information technologies, and exposure of programme managers to strategic conversations.

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I thank God the Almighty for allowing me to undertake this journey, provide me with the useful resources in human form and otherwise, and provide guidance and protection throughout. He watched over me, straightened some areas and provided the much needed light on my path. To Him be the Glory.

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To the Free State Provincial Department of Health, thank you for the time you spent assisting me in the collection of data and for your valuable input onto the completion of this study.

Lastly. this research is part of a bigger research on COVID-19 pandemic and health systems' response in South Africa and Malawi. I acknowledge that the RSA part of this study received funding from the South African Medical Research Council (SA MRC) under a Self-Initiated Research (1) Grant. The findings from this report inform the bigger study. The views and opinions expressed are those of the author(s) and do not necessarily represent the official views of the SA MRC.

Contents

List of tables 8
Definitions of Terms, acronyms and abbreviations 9
CHAPTER 1: BACKGROUND AND LITERATURE REVIEW 10
1.1 Background 10
1.2 Literature Review 11
1.2.1 Childhood immunization and its benefits 11
1.2.2 Immunisation coverage globally and nationally 12
1.2.3 Immunisation coverage in the face of an emergency 13
1.2.4 Effect of COVID-19 on Immunisations and other Health Services 14
1.2.5 Literature gaps addressed by the study 14
1.3 Statement of the problem 17
1.4 Justification for the Study 18
1.5 Aim of the Study 18
1.6 Study Objectives 19
CHAPTER 2: METHODOLOGY 19
2.1 Study Design 19
2.2 Study Population 20
2.3 Sampling 20
2.4 Data Collection 21
2.4.1 Quantitative Data Collection 21
2.4.2 Qualitative Data Collection 23
2.5 Data Analysis 24
2.5.1 Quantitative data analysis 24
2.5.2 Qualitative data analysis 25
2.6 Ethical Considerations 26
CHAPTER 3: RESULTS 27
3.1 Introduction 27
3.2 Quantitative data results 27
3.2.1 Immunisation access of children aged 0-12 months, 12 months before and 12 months after the emergence of the COVID-19 pandemic in Free State, South Africa 28

3.2.2 Immunisation access of children aged 0-12 months, 12 months before and 12 months after the emergence of the COVID-19 pandemic by district in Free State, South Africa 29
3.3 Qualitative data results 30
3.3.1 Risk Communication and Community Engagement 40
CHAPTER 4: DISCUSSION 42
4.1 Introduction 42
4.2 Number of children immunised in the Free State Province before and after the emergence of COVID-19 42
4.3 The effects of the COVID-19 pandemic on EPI services from the perspective of the health care providers 43
4.3.1 Service Delivery 43
4.3.2 Health Workforce 44
4.3.3 Health Information systems 45
4.3.4 Essential Medicines, Vaccines and Technologies 46
4.3.5 Health Systems Financing 46
4.3.6 Leadership and Governance 47
4.3.7 Risk Communication and Community Engagement 48
4.4 Possible solutions to ensure maintenance or improvement in EPI service provision in the face of health emergencies in the Free State Province 48
Conclusion 49
Recommendations 50
References 52
Appendix 1 57
Appendix 2 64
Appendix 3 65
Appendix 4 66
Appendix 5 67
Appendix 6 68

List of tables

Table 1: Immunisation indicators for children between 0 and 12 months 22
Table 2: Rank sum test of 0-12 months old children immunised before and after the covid19 first case in Free State Province in South Africa. 28
Table 3: Rank sum test of 0-12 months old children immunised before and after the covid19 first case in the five districts of Free State Province in South Africa. 29
Table 4: WHO building blocks based themes. 31
Table 5: additional emerging themes 32

Definitions of Terms, acronyms and abbreviations

ARCC:	African Regional Certification Commission
BCG:	Bacille Calmette-Guerin
CHC:	Community Health Centres
COVID-19:	Coronavirus disease 2019
DHIS:	District Health Information System
DOH:	Department of Health
EPI:	Expanded Programme on Immunisations
EPI-SA:	Expanded Programme on Immunisation- South Africa
GVAP:	Global Vaccine Action Plan
KII:	Key informant interviews
LMIC:	Low- and middle-income countries
MAL-ED:	Aetiology, Risk Factors, and Interactions of Enteric Infections and Malnutrition and the Consequences for Child Health
PCV:	Pneumococcal Conjugate Vaccine
PHC:	Primary Health Care
RCCE:	Risk Communication and Community Engagement
SDG:	Sustainable Development Goals
UHC:	Health Coverage
WHO:	World Health Organization

CHAPTER 1: BACKGROUND AND LITERATURE REVIEW

1.1 Background

The global novel Coronavirus, which originated from Wuhan, China was named COVID-19 globally and the World Health Organization (2) declared the disease as a public health emergency of international concern (3). South Africa had the first case of COVID-19 on 5 March 2020 and has since then seen a rapid transition from imported cases to community transmission and an increase in rates of infection. This rapid increase saw the number of cases sitting at 202 within a space of 2 weeks, with an average relative daily increase of 34.67 cases (4). This led to the Presidency announcing a complete national lockdown, effective from the 26th of March 2020, which was subsequently applied at different alert levels, to decrease the rate of the spread of the pandemic through enforcing physical distancing (5). This was thereafter followed by different activity restriction levels based on the five-level COVID-19 alert system that was introduced to manage the gradual easing of the lockdown. This risk-adjusted approach was guided by several criteria, including the level of infections and rate of transmission, the capacity of health facilities, the extent of the implementation of public health interventions and the economic and social impact of continued restrictions.

For about a month the country went into total lockdown from 26 March to 30 April 2020, which was the alert level 5, and started fluctuation among the different alert levels until October 2021. Alert level 4 was in force from 01 to 31 May 2020 and again from 28 June to 25 July 2021. These two alert levels had the most impact on movement and different economic activities. With these lockdown restrictions, it was anticipated that a 9 - 18% reduction in maternal, neonatal and child health coverage 6-months would lead to an additional 2 160 child deaths at a minimum in South Africa (6). In addition to the overwhelmed human resources at healthcare facilities due to the intensified focus on COVID-19 and transport restrictions imposed by the lockdown (6), the social fear has resulted in a reduction in utilisation of primary healthcare (7-9) services, including maternal and child health (10).

Administration of vaccines before exposure to disease has been known to provide a huge benefit in the control of morbidity, mortality and other complications of preventable disease (11). The

benefit is not limited to the vaccinated individuals but covers the entire population in terms of improving life expectancy in general and preventing serious diseases that would incur economically crippling cost of care (11, 12). Routine provision of childhood immunizations through the Expanded Programme on Immunisation of South Africa (EPI-SA) forms one of the major elements of Primary Health Care (PHC) provision in South Africa. Childhood immunisation, as a public health measure is central to the attainment of universal health coverage (UHC) and sustainable development goal (SDG) (13). This requires visits to PHC facilities according to the EPI schedule, to reach and protect each and every child in the age group targeted by the schedule (13). The impact of universal coverage with appropriate immunizations for eligible people at appropriate intervals cannot be underestimated as it has great impact and contribution to economic development and in meeting disease eradication and elimination goals (14). On a broader social impact, the return on investment amounts to about 16 times in terms of the averted cost of treatment of vaccine preventable diseases (VPD) and loss of productivity in the populations that received vaccination (15).

1.2 Literature Review

A literature review was conducted prior to the development of the research protocol and areas of further research were identified. Due to continuous research in the field both locally and globally, additional literature review was conducted to either substantiate or challenge the findings of this research.

1.2.1 Childhood immunization and its benefits

Childhood immunisation is designed to protect children from vaccine preventable diseases, thus reducing the burden of disease and as well as lower morbidity and mortality among immunised populations (11). A study published by Shah et al revealed a drastic reduction in hospitalisations globally, that are due to childhood diarrhoea in 29 countries since the introduction of Rotavirus into routine vaccination programme by the end of 2014, including South Africa (16). The African countries would usually account for 39% of these global Rotavirus deaths (17). An estimated 130 000 hospitalisations and 21 000 deaths were prevented in these countries, with South Africa being ranked among the low (< 67 deaths per 100 000 live births) mortality group since the introduction of the vaccine (13). With the provision of immunisations, in addition to other child

health interventions, despite the increase in the number of children born in Africa , the estimated deaths had dived from the year 2000 estimate of 9,2 million to an estimated 7.2 million deaths by 2010 (2). It is, however, concerning that even with the benefits of immunisations reducing mortality by just above 20% in 2010, about 10 years later, there are still challenges with the implementation of EPI. Cameroon is one example of such African countries, reporting an estimate of 60% immunisation coverage and an average of 18% deaths from vaccine preventable diseases (18). Some of the cited barriers to successful implementation of EPI, include sub-standard education to the caregivers, limited health resources, poor governance and leadership as well as other infections such as COVID-19 (18).

1.2.2 Immunisation coverage globally and nationally

The EPI programme dates as far back as 1974, when WHO established it to provide for global immunization coverage, which initially catered for six vaccine preventable diseases that included diphtheria, pertussis, tuberculosis, poliomyelitis, tetanus and measles (19, 20). The coverage increased rapidly from about 5%,reaching 20% in six years (19). Although substantial progress has been seen in global coverage in general, coverage with DTP3, OPV3, and Measles1 have remained unchanged between 2010 and 2016 at ranges of 84% to 86%. (20-22) The WHO African region has been seen to be the least performing with all the vaccines between 2015 and 2017, with ranges from 41% to 46% showing an increase for Rota and 72% to 76% showing a decline across the years (20-22). Of all the vaccines, the Bacille Calmette-Guerin (BCG) is likely to have the highest coverage, mainly due to its administration being at birth, while the administration of other vaccines relies on the caregiver taking the child to the facility (23).

An association between low immunization coverage as well as incomplete routine immunisation and circumstances such as low-income country status, lower maternal education levels and low socio-economic status, has been identified in several studies (19-23). Community demand creation has been emphasized and advocated for (19), which COVID-19 has presumably disrupted. Other factors that may influence the uptake of immunisations include vaccine stock-outs, global shortages of vaccines seen in past years (24), staff shortages and high workloads, some health care

facility levels such as non-PHC facilities not providing immunisation and challenges with management of cold-chain maintenance (25).

Despite the noted progress, such as being the first African country to simultaneously introduce pneumococcal conjugate vaccine (PCV) and Rota in 2009 (26), since the introduction of EPI South Africa (EPI-SA) in 1995, significant challenges have also been documented in the country (27).These include all age-appropriate vaccinations low coverage of just 52,7% of children aged between 12 and 23 months and just 77% of fully immunised children under 1 year in 2016 and 2017 respectively, a far cry from the Global Vaccine Action Plan (GVAP) recommended target (27). Amid such challenges South Africa managed to get certified for the second time as Polio free by the WHO's African Regional Certification Commission (ARCC) in September 2019, after satisfactory demonstration of coverage of more than 80% of children with three doses of intramuscular Polio injection (28), with the last case having been seen in 1989 (29).

1.2.3 Immunisation coverage in the face of an emergency

Much as there have not been any significant numbers reported of children infected with COVID-19, the impact on their health is still huge in low- and middle-income countries (LMIC), particularly in the Sub-Saharan Africa region, both directly and indirectly (11, 12). This is due to, among other challenges, the risk of low immunisation uptake due to the government imposed restrictions in movement. The potential impact of shifting of resources to COVID-19 response, which has resulted in disruption of essential services has been anticipated to result in reduced access health services. An estimated 18,5% to 59,9% reduction in the provision of routine childhood immunisation in 118 Countdown to 2030 countries, could, in turn result in an estimated between 1% to 2% increase in child deaths each month (12). Around the same time as the beginning of Level 5 lockdown in March, WHO recommended a temporary suspension of mass vaccination campaigns (30) and to only continue with routine vaccination in facilities with adequate operational capacity. Around July WHO issued a recommendation for countries to continue with routine immunisations to reduce the risk of other diseases, while battling with COVID-19.

Previous South African research in 2010 has shown the negative impact of the diversion of health workers' attention to focus on a single issue – in this case, a catch-up campaign for measles (6). In 2010, over this same 3-week period in 52 districts, there was a 30% decrease in children completing the primary course of immunisation, a 10% decrease in antenatal visits, and a 12 - 17% decrease in use of injectable contraceptives (6).

1.2.4 Effect of COVID-19 on Immunisations and other Health Services

A survey conducted among the Immunising Pregnant Women and Infants Network (IMPRINT), in 51 member countries across the world to determine the extent of disruption caused by COVID-19 on maternal and infant immunisation services, established that COVID-19 caused disruptions in these services in both low-middle income countries (LMIC) and high income countries (HIC) (31). Although both the LMIC and HIC attributed the disruptions to the COVID-19 restrictions, it is mostly the LMICs that reported health system-related barriers such as vaccine shortages and staff shortages (31). A study by the Human Sciences Research Council established the socio-demographic factors such as level of education and geographical area as the number one determinants of parents taking their children for immunisations during the COVID-19 emergency period (32). The unequal distribution of health resources and aggravated situation of the pre-COVID-19 shortages of personnel are also cited as a negative effect of the pandemic (33). A lasting intervention for the gaps in the health system has been proposed in two studies conducted to remedy the impact of COVID-19. These include closure of all the gaps that result in missed opportunities on vaccination (34), implementing recovery measures (35) and improving the resilience of health systems (7).

1.2.5 Literature gaps addressed by the study

As much as the available literature has indicated the drastic reduction in hospitalisations and deaths in Africa since the introduction of immunisations (2), overcoming challenges that threaten the maintenance of such, is still facing multiple challenges . This study is exploring practical experiences of implementers on the challenges of the EPI programme in the face of a medical emergency. Staff shortages, presumed disruption of community demand creation for EPI services, vaccine shortages and limitations in mobility have all been reported as some of the actual or

presumed factors that negatively affect the full uptake of the immunisations (12, 13, 18, 19, 24, 31, 33). To get the full picture of the specific province selected, these were studied in more details to determine how the COVID-19 emergency contributed to the staff shortages and vaccine shortages, whether the access to EPI was affected due to the pandemic, specifically in the Free State province. This was to further determine the health systems gaps that need to be addressed and how they can be addressed. The results of the study will contribute to the bridging of the gaps and improvements on the building blocks of the health system.

1.3 Theoretical framework guiding the study

In this study we applied a conceptual framework that was adapted by Nyasulu et al from the World Health Organization (WHO) health systems framework (8, 36).

In 2007 the WHO put together and published a health systems framework that would encompass all the building blocks that define the desired qualities of a functional health system. The framework is one of the four pillars of WHO's responses to the challenges of health system strengthening agenda clarities and functional linkages between health programmes and the specific health outcomes of the health system. Its primary focus is to facilitate a full understanding of what constitutes a health system and how the health system can be strengthened, utilising the six building blocks as the guiding principles (36). While these building blocks define separate components that make up the health system, they are interdependent on one another and, therefore, require an integrated approach in their strengthening efforts. The interdependent building blocks the framework addresses are:

i. Health service delivery is about delivering safe, effective and good quality preventative, curative or rehabilitative care to those who need it, when and as needed. The study explored any service delivery challenges related to the EPI programme, which were experienced during the COVID-19 emergency period, which were not there in the pre-COVID period.
ii. Health workforce refers to all the people involved in actions that protect and improve the health of the population, including service providers, management and health support workers. The study explored the manner in which the emergence of COVID-19 may have affected the utilisation of the workforce and how that disruption affected the delivery of EPI services.

iii. The health information Systems building block refers to a well-functioning health strategic information system that ensures reliable, timely and accurate collection, analysis, dissemination and utilisation of health data, to inform programme implementation and decision making. In the context of EPI during the COVID-19 emergency, any disruptions in data collection and utilisation would translate to inability to monitor the immunisation uptake and the resultant difficulty in identifying immunisation gaps.

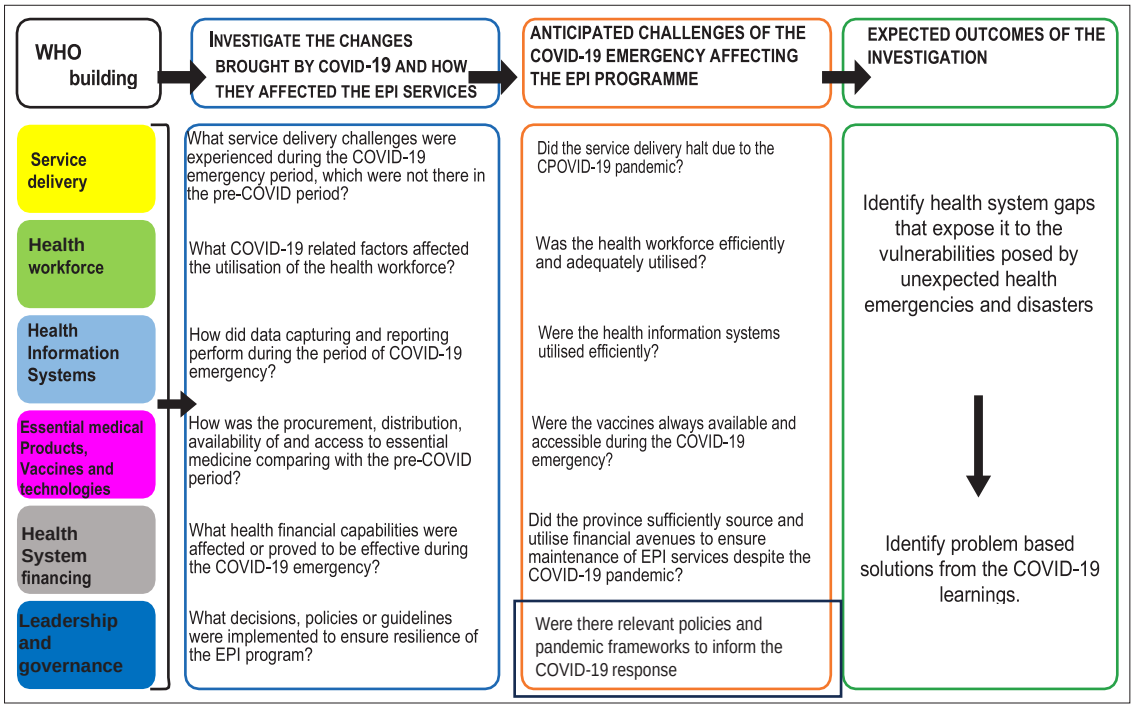
iv. The medical products, vaccines and technologies building block is about ensuring equitable access to essential medical products, vaccines and technologies necessary to carry implement health programmes. For continued delivery of services, the childhood vaccines are necessary, and the study explored the potential interruption of EPI services to shortages of vaccines.

v. A health financing system raises adequate funds for the necessary health interventions, to ensure universal access to the needed health services, and protection from financial risks that can threaten the delivery of equitable and effective health care. This study explored the level at which financial capabilities may have been negatively affected by the COVID-19 pandemic, resulting in challenges with EPI services delivery.

vi. The leadership and governance block involves ensuring the existence of strategic policy frameworks, which are implemented through effective oversight, internal and external collaborations, development and monitoring of appropriate regulations, and accountability. The study explored the contribution of any policies or guidelines that were used to ensure resilience of the EPI programme during the COVID-19 emergency.

In their study, assessing the effects of the COVID-19 pandemic on the health system in South Africa. Nyasulu and Pandya applied the WHO framework health system building blocks, adapted for the study (8). The adapted framework served as a guide in systematically answering the health system challenges raised and coming up with recommendations. It demonstrates how structured and comprehensive attention to all the building blocks can be applied and prioritised for health systems strengthening. Its application in the study provided a clear view of which building blocks need urgent attention and to be prioritised in interventions.

Figure 1: Adapted conceptual framework based on the WHO building blocks of health systems, (8).



As shown in **Error! Reference source not found.** above, the framework, the KII questions focused on the effect of the COVID19 pandemic on delivery of the EPI program and interventions to address these guided by the WHO building blocks.

1.3 Statement of the problem

The importance of maintaining childhood immunisation services, which are essential for reduction of morbidity and mortality that is due to vaccine preventable diseases cannot be overstated and has posed a high risk during the disruption in continuity of routine health care services due to the COVID-19 pandemic as global evidence has shown (37). Some studies have recommended closure of the gaps that result in missed opportunities for immunisations (35) and improvement on the resilience of the health system (7). The study is, however exploring whether there has been a disruption in the provision of EPI services and, if yes, what specific health systems gaps need to be addressed to lower the risk of missed opportunities. Maintenance of sufficient immunisation coverage is extremely important in averting millions of preventable childhood illnesses (35). This study provides evidence and analysis of childhood immunisation uptake and access status and demonstrates the extent of disruption in EPI services in the Free State Province, related to the

emergence of the COVID-19 pandemic in South Africa. Its outcomes will inform the provincial department of the differences in the uptake of EPI service before and after the COVID-19 pandemic, the extent of the disruption in EPI services and the gaps brought about by the pandemic and recommended interventions to bridge them.

1.4 Justification for the Study

EPI is one of the measures of child health provision and forms part of the tracking indicators by the Countdown to 2030 for Women's, Children's, and Adolescents' Health, which tracks participating countries' progress in improving reproductive, maternal, newborn, and child health, one of which is South Africa. During similar pandemics like Ebola, poor access to essential services like immunisations has shown to lead to an upsurge in morbidity and mortality due to preventable diseases (9). This said, it is imperative to understand the extent to which COVID-19 particularly, has affected the delivery of EPI similarly. Moreover, it is not sufficient to know whether the service was affected or not, but it also needs to be understood how it did and how it may have weakened the health system. This study, therefore, is important to assess how the emergence of the COVID-19 pandemic has affected immunisation access, to identify gaps in EPI service provision and possible solutions towards improving uptake and access in the face of similar emergencies and hopefully influence action. The understanding of the extent of changes in childhood immunisation access and uptake in the face of the COVID-19 pandemic will help to shape improvement interventions and inform planning around the EPI programme. It will further provide a foundation for the improvement of the gaps in the health system.

1.5 Aim of the Study

The aim of the study was to describe the uptake and access to, and explore the effects of the pandemic disruption on the Expanded Programme for Immunization services among children aged 0 to 12 months during the COVID-19 pandemic, explore the effects in Free State Province, South Africa.

1.6 Study Objectives

1. To describe and compare immunisation uptake and access of children aged 0-12 months, 12 months before and 12 months after the emergence of the COVID-19 pandemic in Free State, South Africa.
2. To explore the effects that the COVID-19 pandemic has had on provision of EPI services since its emergence, from the perspective of the health care provider.
3. To explore possible solutions in ensuring maintenance or improvement in EPI service provision in the face of the COVID-19 pandemic in the Free State Province in relation to the WHO building blocks of a health care system.

CHAPTER 2: METHODOLOGY

2.1 Study Design

This is a descriptive exploratory (38) research study using a mixed method approach, whereby both quantitative and qualitative data was collected and analysed sequentially. Quantitative secondary EPI data from the province was used to establish EPI access. Sequentially, qualitative data was collected through key informant interviews (KII) with the provincial and district managers in the Free State to gain a deeper understanding of the findings from the quantitative data. The comparison of EPI access before and after the emergence of the COVID19 pandemic has assisted in determining the effects of the COVID19 pandemic and to learn whether the data shows any changes in the EPI programme after the onset of the pandemic. For the purpose of this study ‘access’ is measured by the number of immunisations performed in the province as this is all that the data shows. The qualitative data complements the quantitative data by providing an explanation on factors that contributed to the EPI performance. Data analysis was done separately and independently in a single-phase study, and the results of analysis were converged to provide an integrated interpretation of the two data types. The two data sources were useful in triangulating the findings and they complement each other. The interpretation of statistical findings on the patterns of change in EPI access over time, was used in conjunction with the contextual qualitative data to determine evidence informed intervention.

This is a subset of a bigger study titled “Maintaining essential services during the COVID-19 Pandemic: A call to strike the health systems balance in middle- and low-income countries (The South Africa and Malawi Project). The main study aimed at establishing the effects the COVID pandemic had on access to essential health services in the South Africa and Malawi.

2.2 Study Population

The study population consists of two different groups for the quantitative and qualitative components, respectively. For the quantitative component, the study population included all children aged between 0 and 12 months in the five Free State districts, analysing EPI data between March 2019 to February 2020 and March 2020 to February 2021. This population is chosen because beyond 12 months of age the attendance to immunisations generally declines and it would not provide any significant data for the purpose of the study.

For the qualitative component, the researcher purposively approached all programme managers who work with the EPI or Maternal Child and Women Health (MCHW) programmes, one at provincial level and one for each of the five districts, for interviews. Their ages ranged between 40 and 56 years, one male and five females, a mixture of married and single and have all been in the field for more than ten years and in their current position for more than five years.

2.3 Sampling

For the quantitative component, the sample included all children aged between 0 and 12 months in the five Free State districts as per the DHIS provincial records, analysing EPI data between March 2019 to February 2020 and March 2020 to February 2021. This population was chosen because beyond 12 months of age the attendance to immunisations generally declines and it would not provide any significant data for the purpose of the study. It excludes any children older that one year.

For the qualitative component, the researcher used purposive sampling and targeted programme managers who work with the EPI or Maternal Child and Women Health (MCHW) programmes at provincial level and all five districts, for interviews. The purposive sampling was based on the homogeneity (39) of the group, the expectation that these managers have direct experience with the challenges posed by the COVID-19 pandemic and the interventions deployed during the time,

and would be better positioned to understand health system issues. The researcher requested the provincial EPI or MCWH manager to grant permission to interview and provide details of the relevant managers at both provincial and district level. Any managers or health worker not involved with maternal and child health were excluded from the sample.

2.4 Data Collection

2.4.1 Quantitative Data Collection

The researcher used secondary EPI data requested and obtained from the National Department of Health (NDOH). This data that is routinely collected daily by health care facilities and submitted to the district office of the DOH through the District Health Information Systems (DHIS) monthly and is primarily analysed for the purpose of keeping track of the immunisation uptake. For the purpose of this study, the researcher used secondary data analysis of the twelve months before and twelve months after the emergence of the COVID-19 pandemic. The data collection tool was an excel sheet with all the immunisations scheduled for ages 0 to 12 months. The study included all immunisation indicators for children between 0 and 12 months of age collected routinely through the Department of Health's (12) District Health Information System (DHIS). The details of these indicators are described in Table 1.

Table 1: Immunisation indicators for children between 0 and 12 months

Indicator Name	Numerator	Denominator	Indicator definition	Purpose, guide for use and context
BCG coverage (annualised)	BCG	Population under 1	Proportion children under 1 year who received BCG, normally given just after birth	Monitors BCG vaccination to protect children against milliary TB and TB meningitis. Vaccines given as part of mass vaccination campaigns should not be counted here.
DTaP-IPV – HepB-Hib 3rd dose to Measles1st dose drop-out rate	DTaP-IPV/IPV3 to Measles1 drop-out	DTaP-IPV/IPV 3rd dose	Proportion children who dropped out of the immunisation schedule between DTaP-IPV/IPV 3rd dose, normally at14 weeks and measles 1st dose, normally at 9 months	Monitors children who drops out of the vaccination program after 14 week vaccination. Vaccines given as part of mass vaccination campaigns should not be counted here.
DTaP-IPV/Hib 1st dose coverage (annualised)	DTaP-IPV/Hib 1	Population under 1	Proportion children under 1 year who received DTaP-IPV/Hib (Pentaxim) 1st dose, normally at 6 weeks	Monitors protection of children against diphtheria, tetanus, a-cellular pertussis, polio and haemophilus influenzae. Vaccines given as part of mass vaccination campaigns should not be counted here.
DTaP-IPV/Hib 3rd coverage (annualised)	DTaP-IPV/Hib 3	Population under 1	Proportion children under 1 year who received DTaP-IPV/Hib (Pentaxim) 3rd dose, normally at 14 weeks	Monitors protection of children against diphtheria, tetanus, a-cellular pertussis, polio and haemophilus influenzae. Vaccines given as part of mass vaccination campaigns should not be counted here.
HepB 3rd dose coverage (annualised)	HepB 3	Population under 1	Proportion children under 1 year who received HepB 3rd dose, normally at 14 weeks	Monitors protection of children against Hepatitis B. Vaccines given as part of mass vaccination campaigns should not be counted here.
Immunisation coverage (annualised)	Immunised fully under 1 year new	Population under 1	Proportion children under 1 year who completed their primary course of immunisation	The child should only be counted ONCE as fully immunised when receiving the last vaccine in the course (usually the 1st measles and PCV3 vaccines) AND if there is documented proof of all required vaccines (BCG, OPV1, DTaP-IPV/Hib 1, 2, 3, HepB 1, 2, 3, PCV 1,2,3, RV 1,2 and measles 1) on the Road to Health Card/Booklet AND the child is under 1 year old

2.4.2 Qualitative Data Collection

Sequentially, qualitative data was collected, with the purpose of obtaining in-depth exploratory data and substantiate the findings of the quantitative data analysis which showed a slight decline in EPI coverage during the COVID-19 emergency period, in an already underperforming programme. The researcher used key informant interviews the managers involved in the management of EPI or MCWH in the Free State province and district offices, through a virtual platforms. The aim was to obtain an in-depth understanding of the programme performance during the period of analysis and to understand their perspectives on the risk COVID-19 has posed to access to childhood immunisations and their understanding of strategies that need to be put in place to avoid any drawback that might have been caused by the pandemic. The questions were generated and analysed using the COVID pandemic effects on health systems conceptual framework by Nyasulu and Pandya (8) in **Figure *1***.

The researcher used a semi-structured interview guide (Appendix 1), to conduct virtual interviews through the MS Teams platform with the key informants, using the same guide for both the provincial and district levels of management. This method was selected for its ability to collect as much data as the respondents can, fostering in-depth exploration, rich and detailed data collection through further probing and clarification of questions. The interview questions included information about their role in the province and district, to confirm their level of relevance to the objectives of the study, differences in uptake of immunisations between the pre- and post- COVID-19 periods, factors that could have influenced these differences, how the pandemic affected the EPI services delivery, the strengths and weaknesses of the EPI programme with or without the COVID-19 pandemic, and their ideas on what can be done to strengthen or maintain the EPI services. Although the interview guide was guided by a conceptual framework, the researcher avoided mentioning the WHO building blocks during the interviews, to avoid directing the responses. This was done to ensure originality, credibility and reliability of the data collected and the building blocks were rather identified in the responses provided. The researcher established good rapport with the participants to make them comfortable during the interview process. The participants provided similar responses to all the questions, which can be attributed to the homogeneity of the sample.

Prior to the actual data collection, the researcher conducted a respondent driven pre-test of the data collection tool to test for reliability, reduce ambiguity and check for intended interpretation of questions. To avoid contamination of data, this was done by sourcing two programme managers from other provinces engaged through work and academic platforms, to administer the tool on.

For the KII, the researcher used the MS Teams recording feature to collect data. The recording of the interview was communicated to the respondents and consent to record obtained. The recordings were transcribed and cleaned in preparation for analysis.

2.5 Data Analysis

2.5.1 Quantitative data analysis

The researcher analysed data from the DHIS electronic database, disaggregated by district. Only indicators for immunisations for children aged 0 to 12 months were extracted using a data extraction tool (Appendix 2). The study measured the impact of COVID-19 on uptake and coverage of immunisations and was measured by comparison of data collected monthly before (March 2019 to Feb 2020) and after (March 2020-Feb 2021) the emergence of the COVID-19 pandemic using non-parametric tests: Wilcoxon rank sum test and Kruskal Wallis tests. The Wilcoxon rank sum test was used to test the equality of vaccinations between two periods and the Kruskal Wallis test was testing the differences in vaccinated numbers between the districts in the Free State Province. We used these non-parametric tests because the data was not normally distributed (tested using Shapiro Wilk test of normality), and they were counts. The variables measured were the:

- Vaccination period
- Vaccination type and
- Location (district)

Below is the list of DHIS indicators included in this study:

- BCG dose coverage
- DTaP-IPV-HepB-Hib 3rd (Hexavalent) dose to Measles 1st dose drop-out.
- DTaP-IPV/Hib 1st dose coverage (annualised)

- DTaP-IPV/Hib 3rd dose coverage (annualised)
- HepB 3rd dose coverage (annualised)
- Immunisation under 1-year coverage
- Measles 1st dose under 1-year coverage
- Measles 2nd dose coverage
- OPV 1st dose under 1-year coverage
- RV 2nd dose coverage

These indicators measure the immunisation of the infants 12 months and younger to protect them from acquiring preventable diseases such as tuberculosis, tetanus, pertussis, haemophilus influenzae, hepatitis B, pneumococcal diseases, rota virus and measles. These are generally taken at intervals from birth, 6, 10 and 14 weeks, 9 months and at 1 year of age. During the data cleaning stage, however, gaps in data were identified on PCV, OPV, DTaP-IPV-Hib-HBV 2nd dose and Rotavirus between February 2019 and March 2020 and, therefore, a comparison between the 2 periods could not be done. The analysis of data was done using absolute numbers. The quantitative findings are presented in tables in the results section.

2.5.2 Qualitative data analysis

For the qualitative component, the researcher applied the latent thematic analysis method, whereby a five-step process of familiarising, coding, generating themes, reviewing themes, naming and defining themes and interpreting data was applied (40). The researcher transcribed data from the recording device into MS Word online documents, capturing the details of the conversation and examined the correctness of the transcript against the recording device. The researcher listened to the records and read the transcripts to gather an overview of the data collected, become familiar with the key ideas and take note of emerging themes. With the agreed upon support of another Wits MPH student, Motshidisi Ramadi, the researcher developed a code book with thematic codes to guide categorisation of data and these codes were used during data analysis.

The researcher used a coding framework (Appendix 3) to highlight and classify phrases that emerged from the texts to identify themes that correspond with the aim and objectives of the study. Both deductive and inductive coding were used in the framework. For high level and more detailed understanding, these were classified by broad codes and further broken down into finer codes. The

researcher initially used deductive coding guided by the WHO health systems building block framework and definitions (36), and proceeded further to inductive coding . This chart was used to map and interpret the key characteristics of the findings, identify emerging concepts and the associations between these concepts.

In addition to the WHO building block predetermined themes and subthemes, an additional theme of emerged in the findings.

The researcher conducted a MS Word assisted transcription of all the interview recordings. She, then, reviewed, cleaned, quality assured, and content edited parts of the transcription. The edits were made necessary due to the inability of the transcription software to recognise some of the local names of places and the challenges with the local accent. The second stage made use of intelligent verbatim transcription to improve on the readability of the text as some of the conversation fillers were not relevant to the purpose of the interviews.

2.6 Ethical Considerations

The study is a subset of an already approved main study on COVID-19 and primary health care services Protocol # M200706. The main study has the Human Research Ethics Committee (HREC) of the University of Witwatersrand approval and permission to access data from the National Department of Health (Appendix 4 and Appendix 5). The approved study stipulates that it nests postgraduate students both in Malawi and RSA through the University of the Witwatersrand and University of Malawi, The College of Medicine. The ethics approval for the main study was used in this study and permission to do so was granted by the supervisor (Appendix 6). Additionally, to ensure adherence to ethical considerations, the researcher provided a consent form to the participants, with clear information on issues of confidentiality and ensuring privacy while handling data and requested them to provide consent prior to commencing with the interviews. The participants were informed of their right to withdraw from the interviews if no longer feel comfortable. The researcher conducted data collection, transcription and analysis, with no third parties and all data was stored using the researcher’s personal computer. No incentives were provided to the participants. The agreement was had, to provide feedback on the study findings.

CHAPTER 3: RESULTS

3.1 Introduction

This section presents findings from both qualitative and quantitative data with the aim of addressing the objectives of the research. The quantitative results address objective 1, while objectives 2 and 3 are addressed by the qualitative results. The quantitative results are from the DHIS secondary data analysis whilst qualitative data was primarily collected from the Free State province health program managers. The chapter opens with the description of the data analysis, results of the quantitative component followed by the qualitative component.

3.2 Quantitative data results

We compared immunisation access of children aged 0-12 months, 12 months before and 12 months after the emergence of the COVID-19 pandemic in Free State, South Africa. It was established in most indicators that there was non-significant decline in performance. In addition, varied performance among the district in the Free State province were observed.

3.2.1 Immunisation access of children aged 0-12 months, 12 months before and 12 months after the emergence of the COVID-19 pandemic in Free State, South Africa

Table 2: Rank sum test of 0-12 months old children immunised before and after the covid19 first case in Free State Province in South Africa.

Indicator	Rank sum test of children immunised Before	Rank sum test children immunised After	Difference in Rank sum of children immunised (After -Before)	P-value
BCG dose	66126	65715	-411	0.2636
DTaP-IPV-Hib-HBV-Hexavalent 1st	69020	70636	1616	0.6448
DTaP-IPV-Hib-HBV-Hexavalent 3rd	708425	68813.5	-2029	0.5627
Immunised fully under 1year new	70365.5	69290.5	-1075	0.7591
Measles 1st dose	69285	70371	1086	0.7567
Measles 2nd dose	70693	68963	-1730	0.6217
PCV	70446.5	69209.5	-1237	0.7242
RV 2nd dose under 1 year	69697.5	69958.5	261	0.9406

Table 2 summarises the analysis of the number of children immunised 12 months before and 12 months after the emergence of COVID-19. Even though a decline was observed in the uptake of nearly all vaccines (five out of seven), there were no significant no significant differences shown between the two periods. The 12 months after the emergence of COVID-19 show a slight decline in the numbers of children who received DTaP-IPV-Hib-HBV-Hexavalent 3rd dose, under 1 year fully immunised, BCG dose, measles 2nd dose and PCV, by between 411 and 2029. DTaP-IPV-HiB-HBV-Hexavalent, Measles 1st dose and RV 2nd dose show a non-significant increase of between 261 and 1616.

3.2.2 Immunisation access of children aged 0-12 months, 12 months before and 12 months after the emergence of the COVID-19 pandemic by district in Free State, South Africa

Table 3: Rank sum test of 0-12 months old children immunised before and after the covid19 first case in the five districts of Free State Province in South Africa.

District	Analysis	Indicator							
		BCG dose	DTaP-IPV-Hib-HBV (Hexavalent) 1st	DTaP-IPV-Hib-HBV (Hexavalent) 3rd	Immunised fully under 1year new	Measles 1st dose	Measles 2nd dose	PCV	RV 2nd dose under 1 year
Fezile Dabi District	**Number immunised Before**	2190	2362	2478	2547	2421	2672	2530	2465
	Number immunised After	2466	2295	2178	2109	2236	1985	2127	2191
	Difference (After - Before)	-276	-67	-300	-440	-185	-687	-403	274
	P-value	0.3119	0.8061	0.2716	0.1085	0.4978	0.0118	0.1398	0.3154
Lejweleputswa District	**Number immunised Before**	3144	3472	3665	3673	3600	3651	3705	3686
	Number immunised After	3072	3788	3595	3588	3660	3609	3556	3575
	Difference (After - Before)	-72	316	-70	-85	60	-42	-149	-111
	P-value	0.1702	0.4069	0.8542	0.8235	0.8749	0.9122	0.6958	0.7708
Mangaung Metro	**Number immunised Before**	2032	2285	2368	2350	2306	2353	2338	2328
	Number immunised After	2063	2372	2288	2306	2351	2304	2318	2329
	Difference (After - Before)	31	87	-80	-44	45	-49	-20	1
	P-value	0.3273	0.7499	0.7694	0.8719	0.8690	0.8575	0.9416	0.9971
Thabo Mofutsanyane District	**Number immunised Before**	5434	5256	5433	5228	5075	5154	5193	5152
	Number immunised After	5007	5185	5008	5213	5365	5287	5247	5288
	Difference (After - Before)	-427	-71	-425	-15	290	133	54	136
	P-value	0.3936	0.8872	0.3958	0.9761	0.5623	0.7905	0.9141	0.7858
Xhariep District	**Number immunised Before**	1314	1212	1229	1224	1229	1350	1235	1177
	Number immunised After	1314	1416	1399	1404	1400	1279	1394	1451

District	Analysis	Indicator							
		BCG dose	DTaP-IPV-Hib-HBV (Hexavalent) 1st	DTaP-IPV-Hib-HBV (Hexavalent) 3rd	Immunised fully under 1year new	Measles 1st dose	Measles 2nd dose	PCV	RV 2nd dose under 1 year
	Difference (After - Before)	0	204	170	180	171	-71	159	274
	P-value	1.000	0.2503	0.3381	0.3104	0.3353	0.6890	0.3702	0.1226

Table 3 above summarises the analysis of the number of children immunised 12 months before and 12 months after the emergence of COVID-19, using the Wilcoxon rank sum Test to test the equality of vaccinated numbers between the two periods, across all the districts.

Almost all the district municipalities had varied performances and demonstrated no significant differences in children aged 0 -12 months vaccinated during these periods in all other vaccines except for Measles 2nd dose in Fezile Dabi District Municipality had a difference (p-value = 0.0118). To note is that Xhariep district showed only one decline in Measles second dose whilst the rest of the vaccines either remained the same or showed some increase though not significant.

3.3 Qualitative data results

To complement the quantitative findings and obtain a deeper understanding of the context in which the immunization services were delivered and establish possible solutions in ensuring maintenance or improvement in EPI service provision during pandemics, we conducted in-depth key informant interviews with six EPI and MCWH programme program managers from the province and all the health districts. The data was collected from six programme managers who work with the EPI or MCHW programmes, one at provincial level and one for each of the five districts. Their ages ranged between 40 and 56 years, one male and five females, a mixture of married and single and have all been in the field for more than ten years and in their current position for more than five years.

The qualitative component represents the thematic analysis of the effects of the COVID-19 emergency in the Free State Province identified valuable information around the six themes as informed by the WHO Building Blocks of the Health System, as well as two more that emerged. In addition, we had an emerging theme, the role of Risk Communication and Community

Engagement (RCCE). Below is the summary of the themes and subthemes identified from the study.

Table 4: WHO building blocks based themes.

Themes	Sub-themes
Service delivery	- Lockdown - Fear of infection - Halting of mobile community outreach health services including school health services - Closure of schools and defaulter identification - Closure of facilities for disinfection - Non-adherence to some EPI policies by the staff - Catch up campaigns. - Covid-19 response prioritised over other health care programmes.
Health Workforce	- Infections, illness and deaths of health workers - Repurposing of staff for COVID-19 interventions - Additional responsibility at facilities - Shifted focus to COVID-19 screening. - Pre-COVID challenge of staff shortages
Health information systems	- Declining numbers of immunised children in certain sub-districts - Fewer data capturers in the facilities - Backlogs in data capturing - Strategic Information learning opportunities - Nonadherence to the SVS system monitoring - Incomplete immunisation data
Access to essential medical products, vaccines and technologies	- Availability of vaccines - Inefficient vaccine inventory monitoring - Slowing down of vaccine deliveries - Vaccine stock outs in some facilities
Health system financing	- Non- availability of data and information technology equipment
Leadership and governance	- Public Private Partnership - Clear and timely communication

In addition to the WHO building block predetermined themes and subthemes, an additional theme Risk Communication and Community Engagement emerged as shown below.

Table 5: additional emerging themes

Themes	Sub-themes
Risk Communication and Community Engagement	- Messaging ambiguities - Need for RCCE strengthening. - Marketing of childhood immunisations - Harmonisation of messaging - Virtual community outreach

3.3.2 KII results by WHO building blocks3.3.2.1 Service Delivery

Under the service delivery theme, all the respondents mentioned the following: that there was a disruption of EPI services that was a result of the hard lockdown as people, including caregivers of children due for immunisation we reluctant to attend health care facilities. Related to the non-attendance of health facilities, the respondents also mentioned the following sub-themes:

- **Lockdown:** The program managers highlighted that lockdown resulted in limited mobility. The respondents mentioned that that there was a disruption of EPI services that was a result of the alert levels 5 and 4 of the lockdown as people, including caregivers of children due for immunisation we reluctant to attend health care facilities.

"*Remember that the police were all over, and the army as well. Child minders and parents attempting to comply with the instruction…" (Manager 1)*

"*…first two quarters, say April to June, July to September, our coverage went down. It really went down. Mothers did not come to the facility." (Manager 3)*

- **Fear of infection:** The fear of being infected by COVID-19 was also cited as one of the reasons people did not bring their children to the facility for immunisations.

"People tend to say 'no, I don't want to be criminalized, I don't want to be arrested, but more than anything, I don't want to catch Covid, you know' so they stayed indoors." (Manager 1)

- **Halting of mobile community outreach health services including school health services:** The program managers reported that due to lockdown and prioritisation of the COVID-19 response, the community outreach services had to be halted, resulting in a reduction in the number of children immunised as some of the communities are dependent on the mobile health services. The CHWs who are mostly responsible for the community outreach were not able to reach all the children as they were scattered in the community.

"The problem is that the CHW in 'sub-district X' were shifted to bigger COVID-19 sites, vaccination sites…" (Manager 2).

- **Closure of schools and defaulter identification:** The respondents cited the closure of schools that affected the community access by the CHWs and made it "difficult to find the children all over the community". During this time, the CHWs could not conduct creches and primary school visits for defaulter identification as the creches were also closed. Conducting home visits was not feasible.,

"It is easier to "find the children under one roof, but with children scattered through our communities, it became quite difficult to get all our children, and the parents were reluctant to allow visitors into their homes" (Manager 2).

- **Closure of facility for disinfection:** There were periods where some facilities would be closed for disinfection, and this would affect the delivery of services during the closure.

"And clinics was also closed for short periods for up to a week or two weeks in that time period that the staff shortages was for cleaning and all that type of things." (Manager 4).

- **Non-adherence to the policy to some EPI policies by the staff:** There were and still are some facilities that are still following the practice of providing immunisations on certain days in the week. This practice made access to immunizations get even worse during the COVID pandemic.

"… let's say you go to clinic X, you find that children that came for immunisations did so on Wednesday … and we have seen that picture, just too many times. It means that that policy of 'every day is immunisation day' is not being adhered to." (Manager 1).

"Adhering to our Road to Health booklet monthly dates because our road to health booklet guides us. If colleagues can just maintain protocol, because if, if, if we and if we adhere to our monthly routine follow updates." (Manager 5).

- **Catch up campaigns:** The respondents reported that to counter the effects of COVID-19 on the uptake of EPI services they planned and implemented catch up campaigns for the children who had missed their immunisations.

"So we did a catch up plan and now it's actually a yearly thing you know… for every financial year we do a catch up" (Manager 3)

"We just started doing the door to door campaign, now going to the community, trying to see if at all really, people were not coming or so… definitely it did pick up. It was clear that people were maybe afraid of coming to the clinic…" (Manager 6)

- **Covid-19 response prioritised over other health care programmes:** The programme managers also highlighted the shifting of focus from all other programmes to focus on COVID-19 interventions, creating a shortage in the facilities and challenges with rendering of services including EPI programme services,

"At first, yes, at first in the whole of the district, some of the nurses were taken out of facilities to do COVID-19 vaccinations, so it created a problem in facilities." (Manager 2).

"…when I remember, specifically the first school that we went and did a mass screening testing, everybody was involved from the director, the health promotion team, all the coordinators. Some of the professional nurses from the mobiles all went there. So, we did have to take some, especially some of the mobiles, the school, our team, they remember schools were closed, so the school health team came to assist with the covid." (Manager 3).

3.3.2.2 Health Workforce

All the respondents mentioned that the health workforce, including both clinical and non-clinical personnel were affected negatively by the COVID-19 emergency period. One of the significant factors that contributed to the disruption of services after the emergence of COVID-19 was the scanty availability of staff at the facilities. The following sub-themes under the Health Workforce theme, emerged:

- **Infections, illness and sick and death of health workers:** Some of the staff were getting infected with COVID-19, getting sick and some were dying.

"With staff getting sick, staff getting infected, staff that passed on, it really affected our primary health care services in a great way, because it's not easy as I think you should know that staff isn't replaced, like is they are leaving." (Manager 2).

- **Repurposing of staff for COVID-19 interventions:** Some staff members were repurposed for the COVID-19 response activities such as community screening, contact tracing and case investigation, leaving a vacuum in the facilities, particularly among the medical staff.

"Our mobile services was really badly affected because most of the sisters within the mobile's clinics were now used to do COVID related to work. They were doing the testing and swabbing of clients and even doing case investigation and they were also doing contact tracing and that went on for a very long period." (Manager 4).

- **Additional responsibility at facilities:** The managers described how Covid-19 placed a huge strain considering the additional workload at the facilities brought about by the pandemic.

"You know, if I can get real when you go to a facility and there's only two professional nurses on duty… The one that still must do the COVID test, must do their donning and doffing. She must do all that undressing and dressing up… and then they have a lot of people waiting to be tested and one professional nurse is doing both Chronic, Maternal and child and acute." (Manager 2).

"So COVID has taken our staff away and it has also stolen our staff morale" (Manager 2).

- **Pre-COVID challenge of staff shortages**: some respondents pointed to a pre-existing challenge of staff shortage as one of the reasons for inefficient delivery of EPI services, which was aggravated by the emergence of COVID-19. To intervene in that situation the respondents suggested adherence to a good clinician-patient ratio.

"… we must have a healthy ratio of those health cadres to the catchment population because if we don't do that, the quality of child health services in this instance will be compromised" (Manager1).

3.3.2.3 Health Information systems

- **Declining numbers of immunised children in certain sub-districts:** The respondents reported that the districts and sub-districts most affected by the decline in immunisation coverage were the ones that were already underperforming and those were the most populated and the bigger effect was attributed to rapid urbanisation and the highest rates of COVID-19 infections in these areas. The higher the population mean more difficulty in reaching them for health care services.

"We have already seen the speed at which informal settlements are mushrooming. It's unfathomable. I mean you sleep tonight with an open field that doesn't even have a shack. But the following morning there are 20 shacks there, that have erupted, and those people are within the borders of your country… That thing is not going to stop anytime soon, so we must come up with strategies to accommodate situations like those." (Manager 1).

"Sub-district X was most affected because that is where the highest number of cases were." (Manager 3).

"So they actually plummeted. They went further down. They were not performing but they went further down due to COVID." (Manager 2).

- **Fewer data capturers in the facilities:** The respondents reported that all facilities are staffed with data capturers, however, during the COVID-19 emergency the collection of data was greatly affected by the absence of data capturers for different reasons. This was reported to be due to the COVID-19 mobility restrictions and the intervention approach of all staff members attending to the facilities on alternate days.

"Yes, yes, as I said that was caused by the fact that the data capturers were not reporting for every day. If there are four. on any given day, two will be on duty because the other two will be at home, so we were rotating like that." (Manager 1).

- **Backlogs in data capturing:** the alternate days attendance to the facilities by data capturers resulted in data capturing backlogs.

"They were not capturing daily as the norm was because they were not there every day, but when they were there, they would work past 4:00 o'clock to try to push the backlogs" (Manager 1).

"Then we have shortage of staff in the clinics, in all aspect… it might be a nurse who is supposed to be immunising. It can be a data capturer who's supposed to be capturing and not capturing on time." (Manager 6).

- **Strategic Information learning opportunities:** It was reported that despite the data capturing and reporting challenges that already existed in the facilities, the pandemic brought a wakeup call on the need for frequent monitoring of data collection at all facility levels and address any information gaps on data collection and processing.

"*I might say, let me say it's not knowledge gap as such it's monitoring that, I think was not done supervision and monitoring because it actually end up being picked up by the people from the district rather than the facility itself." (Manager 6).*

- **Nonadherence to the SVS system monitoring:** It was reported that facilities were not compliant with the Stock Visibility System (SVS) monitoring and this in some instances resulted in stock out incidents. This became more pronounced during the COVID-19 emergency period as it made the situation worse. This was, however, addressed by the district and provincial management and more attention was paid to the management of stock visibility data.

"Some facilities were poorly compliant to the SVS reporting system" (Manager 2).

- **Incomplete immunisation data:** The managers reported that although there were no issues of shortages of BCG and Polio vaccines at the facilities, there were issues of incomplete immunisation data, which became more pronounced during the remedial facility visits done when COVID-19 restrictions were eased. COVID-19 brought the opportunity to train health personnel on strategic information.

"…if at all there is the decline it was because of non-capturing. Whatever we picked up as we were doing rounds in other hospitals… They kept charting. They were not aware that they're supposed to be capturing. OPV and BCG at birth. So, it's not that it was not given, it was just an era of capturing that they didn't know. (Manager 6).

- **Use of immunisation chart:** Despite the disruption of services, the managers reported that during the COVID-19 period, the districts continued to utilise the Immunisation Chart, used as a

barometer for immunisations was helpful in tracking the performance against targets and informing a plan of action.

"In our district we had Immunization monitoring chart, which is the EPI when I visit facilities, I would tell them our immunization monitoring chart is our is our EPI graph and it informs us." (Manager 2).

3.3.2.4 Essential Medicines, Vaccines and Technologies

- **Availability of vaccines:** it was reported that the vaccines were always available in the depots. The continuous availability of vaccines was made possible by the availability of roving pharmacists and the Central Distribution Unit, which monitors stock movement.

"Our vaccines, our availability at the medical depot has never been found wanting" (Manager 1).

- **Inefficient vaccine inventory monitoring:** we established that the only isolated cases of stock outs that were reported were due to inefficient inventory management and the depots delivering incorrect items or short dated stock.

"Some facilities were poorly compliant to the SVS reporting system" (Manager 2), which led to inventory management and stock outs.

- **Slowing down of vaccine deliveries:** The respondents reported that the emergence of COVID-19 contributed to slow delivery of medicines between the depot and the facilities due to the mobility restrictions of the lockdown as well as the pre-COVID poor compliance with the SVS system.

"Also, people at the depot couldn't deliver on time. And then we also had vaccine in stock outs that contributed to low coverage." (Manager 6).

- **Vaccine stock outs in some facilities:** Participants reported that the districts made use of stock rotation between facilities when the depot could not deliver.

"And by report on stock available the numbers available, and then they immediately see it's been captured. It's a national system if I understand it correctly and then it's immediately picked up and stock moved between clinics if needed." (Manager 4).

"… as I'm saying, we cannot say there were stock outs". (Manager 6).

3.3.2.5 Health Systems Financing

No concerns around the health systems financing building block challenges were mentioned by the respondents except for non-availability of data and other information technology equipments necessary for capturing and management of data.

- **Non- availability of data and information technology equipments:** The respondents cited unavailability of data and information technologies (IT) solutions affecting the capturing of data were there before COVID-19, causing data capturing challenges.

"So I think with capturing there's only a challenge when there's a challenge with IT, things the modem or data or the person is not on duty." (Manager 3).

3.3.2.6 Leadership and Governance

- **Public Private Partnership:** The respondents attributed the success of the EPI programme to the strong Private Public Partnership (PPP) strategy which resulted in the support of development agencies such as WHO as well as the collaboration between private and public health providers.

"Also, the strength of this program I think is the support from WHO, you know, our private practitioners, our private, your clicks, your Dischems, who also give under 5 immunizations." (Manager 3).

- **Clear and timely communication:** The managers felt that during the emergence of the pandemic there were communication challenges. For instance, there was delays and a lack of clarity in the communication to the lower level management. They also reported ambiguity in the messages especially at the emergence of the pandemic. Calling for people to get vaccinated created misconceptions and confusion among caregivers in distinguishing between immunisations and COVID-19 vaccination. It further discouraged them from brining in their children to the health care facilities, to protect them from receiving COVID-19 vaccination.

"*That was our biggest, biggest challenge in the beginning. It was like it's only top people who know about what's happening. So that's our challenge. Country wide, we should learn to communicate to even to the lowest of the lowest." (Manager 3).*
"*And you talk about vaccination instead of immunization. Parents thought that you are going to vaccinate their children with COVID. With or with COVID. So wording. Yeah, that wording plays a very important role."* (Manager 3).

- **Lack of pandemic and emergency preparedness:** They also reported that COVID-19 pandemic caught the healthcare system unprepared for medical emergencies. There was no pre-pandemic contingency planning in place. Emergency preparedness and readiness contingency plans were not in place before the emergence of the pandemic which contributed to delays in response.

"So… that's what I think about in the future like look at KZN… the floods. Also there the response was a little bit like… people take too long to act. When there's an emergency, certain things should be put in place always, like now, look at how Gauteng and the measles. You see, the minister says, don't panic, while if you look at the guidelines, it says where there's two or three, it's an outbreak and handle it as an outbreak" (Manager 3).

- **Pre-COVID handling of staff shortages by the management:** it was reported that the effects of inefficient management of staff affected the delivery of services. The challenge of deceased staff not being replaced, which was there even before COVID-19, remained during the pandemic.

"With staff getting sick, staff getting infected, staff that passed on, it really affected our primary health care services in a great way, because it's not easy as I think you should know that stuff isn't replaced. Like if they are leaving, so the remaining people are to work around COVID." (Manager 2).

3.3.1 Risk Communication and Community Engagement

The risk communication emerged as an additional theme and the sub-themes are summarised below

- **Need for RCCE strengthening:** Some respondents identified a need for more robust advertising and marketing of the EPI programme and misinformation management. They suggested using

the health emergencies as an opportunity to enhance the other pillars of the health care system, such as RCCE, and learn from the lessons and improve.

"I insist when I visit facilities to look at their health education register to see if they are, if they are giving communities health education on EPI. It's important that our posters should also be up." (Manager 3)

- **Marketing of childhood immunisations:** Marketing for childhood immunisations was not sufficient during the COVID-19 emergency period.

"In any situation, I think if our communities are informed then they will better buy into what we have to offer, irrespective of any emergency pandemic that will happen…" Manager 5)

"That that would be my recommendation that we start (marketing EPI) antenatally as well… even in our schools, even at SASSA… those points, they those places. We need to have our billboards up at those places." (Manager 5).

"Then the only thing is if you look even now, it's very rare that you that you see advert on our EPI program." (Manager 3).

- **Harmonisation of messaging:** There is need for harmonisation of response strategies during a medical emergency to minimize contradictory messages from the different government entities.

"Mobilize the community that yes, stay indoors, only go out for very serious reasons. One of the serious reasons that you should go out for to take your child to the clinic for immunization." (Manager 1).

- **Virtual community outreach:** The national and provincial management produced an audio clip to help disseminate EPI messages during the COVID-19 lockdown period.

"It's a health educational clip audio. It came in different languages… So that everyone, even on our work councilors group, we have decided to play that clip. I asked them to just play it on and off so that we remind the communities if we don't reach some of them at least that clip will reach them." (Manager 2).

CHAPTER 4: DISCUSSION

4.1 Introduction

The chapter discusses results established in the study. The aim of the study is to explore the uptake and coverage of Expanded Program for Immunization (EPI) services among Children aged 0 to 12 months during the COVID-19 pandemic in Free State Province, South Africa. The study established that the uptake of EPI services did not differ between the periods before and after the emergence of COVID-19. We also established the varied performances in access to immunizations across the districts. In addition, the qualitative data has established the challenges experienced by facilities in maintaining access to immunization services in line with the six WHO health systems framework building blocks in the province with some solutions to counter act these.

The results seem to suggest that most of the issues that affect the delivery of EPI services existed before the emergence of COVID-19, but the pandemic challenges made them more visible. It can be summarised as a wakeup call brough about by the emergence of the pandemic. The experiences encountered by programme managers will be presented according to the six WHO building blocks of the health system and the two emerging themes. The findings also demonstrated an overlap of the effects of COVID-19 across the WHO building blocks, where a challenge with one building block affected another one or more. The discussion will be divided accordingly into three sections, in line with the study objectives.

4.2 Number of children immunised in the Free State Province before and after the emergence of COVID-19

The results of the quantitative comparison of immunisation uptake 12 months before and 12 months after the emergence of the COVID-19 showed no significant differences in the numbers of children immunised in the before and after period. The same result was shown by both comparisons province wide and by district. This is possibly due to the pre COVID-19 status of vaccination coverage in Free State Province where, during the 2019 EPI survey, only 76,7% of children were fully immunised with all the 14 doses and 80,7% were vaccinated with doses scheduled up to 12 months (41). The MAL-ED cohort study had established the same finding (23). In the year the following the EPI survey, a South African study looking into the missed opportunities reiterated

the sub-optimal immunisation coverage in South Africa and other low to medium income countries (LMIC), which is below the global target of 90% (34). In the in-depth interviews, the EPI program managers reported a national coincidental immunization catch up drive which took place at the emergence of the pandemic in response to the 2019 EPI survey results (42). This could have assisted in counteracting the pandemic effects on the access to EPI services. We therefore propose that during public pandemics like COVID, which hamper access to services, catch up drives should be considered as solutions to counteract the effects.

On the other hand, with the comparison of children immunised, done by district, only Fezile Dabi District showed a significant decline in Measles 2nd dose uptake after the emergence of COVID-19. This is also not considered to have been a direct result of the emergence of the pandemic as the 2019 survey also shows a coverage lower than the 90% target in Free State with a coverage of 72,5% and 88% according to the DHIS and the survey data respectively (41), obtained in the same period. Other issues that existed before the emergence of the pandemic have been cited in other studies, which have affected the stagnation of EPI implementation in South Africa (34), were also explored qualitatively in this study. These are presented in the sections that follow.

4.3 The effects of the COVID-19 pandemic on EPI services from the perspective of the health care providers

Even though there were not much significant differences in access to immunization services before and after the pandemic, the in-depth interviews with facility managers highlighted the experienced challenges and recommendations in line with the WHO health systems framework blocks outlined below.

4.3.1 Service Delivery

The WHO health systems framework defines service delivery as the delivery of safe, effective and good quality preventative, curative or rehabilitative care to those who need it, when and as needed (36). In this study, the researcher sought to understand the EPI service delivery challenges that the province may have encountered during the pandemic, which were not there before. The most outstanding issues that came out regarding service delivery during the pandemic included the limited mobility, which has been cited in other studies as a contributing factor (31), long waiting

time, the limitations of CHWs in reaching out to communities due to the closure of creches and schools, prioritisation of the COVID-19 activities over the regular health programmes, as well as the client's fear of getting infected with COVID-19. The closure of schools resulted in the slowing down of defaulter identification as the CHWs could not visit the creches, a finding similar to Moyo et al study conducted in Limpopo province (43). Considering that the visits to creches has always been a low hanging fruit for delivery of health care services for children, this finding is significant for both the Departments of Education, Health and Social Development to consider pay close attention to prevention of the adverse effects any interruptions in the services of either department. Although the quantitative data did not identify significant differences in immunisation uptake between the 2 periods of comparison, the programme managers reported that the periods of April to September 2021 were largely affected by declining immunisation coverage rates. The respondents did, however, allude to the remedial immunisation campaigns that took place when the lockdown was relaxed (42).

Of particular interest was that the decline in immunisations also coincided with the winter months, which could possibly align with the challenge of care givers lacking motivation to prioritise the children's immunisation (26) and not adhering to the appointment dates. However, the decline in numbers of immunised children was not significant considering that the performance of the province was already below the target of 90% (41). The insignificant decline in EPI services uptake during the pandemic could be related to the fact that, regardless of whether there is a medical emergency or not, the uptake of immunisations generally declines after the 12 month immunisation schedule (27, 43). BCG and Polio, however, were not affected as they are likely to have the highest coverage because they are given at birth as the other studies allude (23, 44) and all the other vaccines depend on the mother to take the child to the facility (23). In terms of service delivery, health system challenges are still a burden in the country including and requires more strengthening.

4.3.2 Health Workforce

Health workforce refers to all the people involved in actions that protect and improve the health of the population, including service providers, management and health support workers (36). Although the study findings show that the health workforce building block was affected negatively by the emergence of COVID-19, the issues raised were not unique to the COVID-19 pandemic as

they were existing before. The major factors that contributed to the disruption of services after the emergence of COVID-19 was the scanty availability of staff at the facilities (31), due to the emergency interventions that the Provincial Health Department had to put in place, including the repurposing of staff for COVID-19 contact tracing and case management activities similar to the Limpopo study (45). As a pillar of the health care system the full complement of staff as a resource for full delivery of the health service should be treated as a priority. The shortcomings of this building block impacts significantly on the health service delivery block, crippling the entire health system. The little availability of staff was, symptom of pre-existing human resource challenges in South Africa, particularly in resource restricted locations, resulting particularly, in missed immunisation opportunities and creating huge gaps in EPI service delivery (25, 34, 46) One of the measures to minimise the risk of infection at the health care facilities was adopting the alternate days' work strategy to reduce the number of people in one confined space at a time. Due to this strategy, there was never a full staff complement in any of the facilities. Other contributors to the low staff coverage were the health care workers getting infected and getting sick, their families and colleagues dying from COVID-19, and some personnel being repurposed to COVID-19 interventions. This placed a huge strain considering the additional workload at the facilities brought about by the pandemic and according to one of the district programme managers, it 'stole our staff morale'. The CHWs vital role of community education and mopping up children who missed their immunisations (47) was missing during this time and the decline in uptake became visible.

4.3.3 Health Information systems

The health information systems building block refers to a well-functioning health strategic information system that ensures reliable, timely and accurate collection, analysis, dissemination and utilisation of health data, to inform programme implementation and decision making (36). The results of the study show that even though the challenges of data collection were brought about by all the COVID-19 issues that affected the daily staff complement, challenges with programme data collection and reporting existed before the onset of the COVID-19 pandemic. The pandemic itself was not the cause of irregular and inconsistent data collection but rather made the challenge more visible and served as a wakeup call on the need for closer and more frequent monitoring of data collection at all facility levels and address any information gaps on data collection and processing.

4.3.4 Essential Medicines, Vaccines and Technologies

The essential medicines, vaccines and technologies building block is about ensuring equitable access to essential medical products, vaccines and technologies necessary to carry implement health programmes (36). For a health system to function properly, the uninterrupted availability of drugs and essential technologies need to be ensured. The study established that vaccines were always available except in isolated cases where it was an issue of stock management or the depots delivering late, incorrect items or short dated stock. All the districts have a Central Distribution Unit (CDU), which made it possible to monitor stock availability, share stock among facilities and to place emergency stock requests, with a roving pharmacist that is responsible for all the facilities. This clearly demonstrates that stock availability was never an issue and has been the strength of the EPI programme in the province and the country as demonstrated in the MAL-ED study where South Africa showed wide availability in all sites (23). It was only negatively affected by the shortcomings of the other WHO building blocks such as poor SVS monitoring, slowing down of service delivery and human errors. This is in agreement with the in-facility stock management recommendation in the 2018 study on vaccine stock outs (26). These were, however, curbed by the swift intervention of the management. On the end of the health care system, the access to essential medicines was ensured by continuous availability of vaccines, it was limited by the lockdown. The availability of all the vaccines made it possible to implement the turnaround strategy for community mobilization for vaccination, which in turn also demonstrates the interrelatedness of all the building blocks.

4.3.5 Health Systems Financing

A health financing system raises adequate funds for the necessary health interventions, to ensure universal access to the needed health services, and protection from financial risks that can threaten the delivery of equitable and effective health care (36). Limited resources have been reported as some of the challenges that contribute to the burden of vaccine preventable disease due to poor uptake of the EPI services (18). During this period Free State had sufficient resources to cover the availability of all the vaccines, which made it possible to implement the turnaround strategy for community mobilization for vaccination. It can be concluded that the province did have resources

for routine procurements but lacked financial contingency planning as its health systems financing issues affected the other areas of service delivery. Issues such as unavailability of data and information technologies (IT) solutions affecting the capturing of data were there before COVID-19, causing data capturing challenges but were aggravated by the pandemic circumstances. The researcher is concerned that this was not identified by any of the respondents as a health systems financing problem, which poses the question of exposure of programme managers to bigger strategic conversations within the provincial health hierarchies.

4.3.6 Leadership and Governance

The leadership and governance block involves ensuring the existence of strategic policy frameworks, which are carried out through effective oversight, internal and external collaborations, development and monitoring of appropriate regulations, and accountability (36). One of the strongholds of any health care system is its leadership and governance to ensure proper and efficient decisions are taken for its benefit (36, 48). The strength of this building block is put to a tough test during such emergencies and any weaknesses in leadership and governance can be a significant factor to an increase in vaccine preventable diseases (18), due to poor EPI uptake. The leadership and management appointment of COVID-19 focal contract staff, in response to the increased burden on the facility staff, was implemented late. In addition, it was an ad hoc reactive decision and not lasting solution to the pre-COVID staff shortages. The provincial leadership needs to conduct pandemic risk assessments and health systems pandemic readiness and preparedness assessments, put emergency preparedness plans in place. Internal communication is another important aspect that the programme managers felt was not done properly, which resulted in confusion about the intervention expectations.

Other studies have identified the same health scare as a challenge that affected many areas such as social aspects, health and economic performance (8, 34, 35). The eruption of informal settlements also makes it difficult to immunise everyone as people move from place to place, as the Kenyan reiterates the effects of COVID-19 on the general health of children in such conditions (49). This is regardless of whether there is a health emergency or not, and it calls for more robust health systems strengthening to ensure that no one is left behind. The fact that COVID-19 aggravated the situation clearly demonstrates the need to review the role of the health systems' leadership in incorporating other social determinants of health and consider including them in the pandemic

preparedness strategy. The need to intervene in the pre-existing challenge of care givers not honouring the appointment dates is evident, as it was also identified in the study conducted in Limpopo province (50).

4.3.7 Risk Communication and Community Engagement

RCCE continues to get downplayed in all health care interventions, yet it is the biggest link between the health care system and the communities it serves. Its role in promoting health care services is so significant (23, 29, 31, 47) it should be considered as an additional building block of the health system. Insufficiency and inadequacy of social mobilization and advocacy has been cited in other studies as well (34), as one of the factors that negatively affect EPI uptake. When the EPI service delivery declined due to COVID-19, the province intensified RCCE, rectifying the messaging, removing the ambiguity from the messages and reaching out to communities and it yielded positive results. The ambiguity in messaging about immunisations or vaccination resulted in misconceptions among the health care users, partly due to the discrepancies between messages originated from the different government departments. This calls for routine RCCE strengthening and misinformation management at all health care management levels as community demand creation remains one of the strong pillars for EPI (19). The lessons learnt from the COVID-19 emergency must be used as an opportunity to enhance the other building blocks of the health care system, such as RCCE and learn from the lessons and improve. During the CPOVID-19 emergency, provincial managers rectified the lack of EPI marketing by engaging in virtual marketing to improve the uptake of immunisation. Continuing with this approach can also be useful in addressing the pre-existing challenge of care givers not honouring the appointment dates, which became worse during the pandemic period a similar challenge reported in the study conducted in Limpopo province (50).

4.4 Possible solutions to ensure maintenance or improvement in EPI service provision in the face of health emergencies in the Free State Province

The provincial Department of Health needs to develop pandemic preparedness and readiness strategy while seeking collaboration with other government departments to ensure a complementary set of interventions. Although the capturing of data suffered during the pandemic lockdown period, it was corrected by having the data capturers back capture the data on weekends.

However, a more advanced information technology system can avoid accumulation of data capturing backlogs. Health sector personnel must be considered as a highly important resource in the delivery of health care services and therefore, the availability of sufficient staff must be ensured all the time. The communication of pandemic response from senior management to lower level management recommendation for the future is for the leadership to intensify emergency response communication among all internal stakeholders to enable all involved to participate fully. The province needs to consider a review of the disaster management policy, readiness and preparedness documents that will guide the strategic management of disasters with the mandates of all the government departments in consideration. The benefit of using different educational methods during an emergency, investment is human resource capacity building and improvement in service delivery, worked and it needs to be made a routine activity.

Limitations the study

- The data analysed is in counts rather than rates. To minimise the risk of inaccurate data, the researcher used non-parametric test analysis
- Incomplete quantitative data collected as it relies on submission by the facilities and considering that data collection was also affected by the disequilibrium caused by the COVID-19 pandemic. To minimise the risk of inaccuracies only data available in both compared periods was analysed.
- The data does not disaggregate according to COVID-19 hotspots, therefore, any conclusion drawn from the analysis is generic.
- The study did not capture the perspective of the clients with regards to access to EPI. The data collected only reflects the perspective of the health care provider.

Conclusion

The aim of the study was to describe the differences in EPI access and uptake before COVID-19 emergence and during the pandemic in Free State and to explore the effects of the pandemic on the delivery of the programme. The reduction in EPI service delivery observed during pandemic from both the quantitative and qualitative data in the Free State Province has been established in other studies in South Africa and elsewhere. The findings of this study, however, show that

although there were challenges with the delivery of EPI services during the period of analysis, no significant declines were seen in the uptake of the service. The good news was that the availability of childhood vaccine stock was maintained while the districts had to come up with strategies of ensuring universal distribution within the province. The emergence of COVID-19 pandemic exacerbated the pre-existing health systems gaps and challenges (6) such as high workloads and staff shortages (25), RCCE insufficiency (19, 34), limited resources and leadership and governance challenges (18). Therefore to ensure maintenance of services like EPI during pandemics like COVID, the province needs to address the existing health systems gaps in line with the WHO building blocks of the health system, pre-pandemic to improve its resilience and that of the EPI programme (7). We recommend health care system investment in an emergency framework for pandemic preparedness and readiness, more robust marketing of EPI services, more advanced data strategic information technologies, availability of staff in facilities and the exposure of the health program managers to higher strategic conversations withing the health system.

Recommendations

The researchers recommend the following interventions to improve EPI services and to overcome a similar experience with any other health emergency that may occur in future.

1. The health care system must invest in an emergency framework that will ensure lasting solutions for pandemic preparedness and readiness.
2. The marketing and communication of EPI services needs to be on the list of priorities for the health care system.
3. Invest in robust surveillance of misinformation spread through the mostly used platforms and engage in a counter strategy
4. Utilise multiple advocacy and social mobilisation strategies that are tailored by context and audiences.
5. Invest in more advanced technologies that will capture all data regardless of the facility a patient received the service.
6. More attention needs to be paid to the availability of a full complement of personnel in all the facilities. This includes a contingency plan for extra pairs of hands should the health system encounter a health emergency similar to the COVID-19 pandemic.

7. More exposure of the health programme managers to bigger strategic conversations so they can understand the health systems building blocks and other important health systems frameworks.

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Appendix 1

Exploring Uptake and Coverage of Expanded Program for Immunization (EPI) services among Children aged 0 to 12 months during the COVID-19 Pandemic in Free State Province, South Africa

Interview Guide

Background Information

The emergence of COVID-19 in South Africa has brought a lot of changes in many aspects of life, including how people access health care services. This research aims to assess the uptake and coverage of EPI during the COVID-19 pandemic period. The purpose of this interview is to collect information from the key persons involved in EPI management provincially and at district. The interview will take between 30 and 45 minutes. Please answer the questions that follow:

Date of data collection	
Interview start time	
Interview end time	
Interview conducted by (name of researcher)	

Demographic information

Age	
Gender	
Race	
Working station (tick one)	Provincial office

	District office
Job position	
Responsibilities within the EPI programme	
Years of experience within the health sector	
Years of experience in current position	

Interview questions

1. Have there been any differences in the rates of EPI uptake between before and after the emergence of the COVID-19 pandemic? Please explain

2. If there are any, what factors could have influenced these differences?

3. Which districts/ facilities have been affected the most by these differences?

4. Which vaccines have been affected the most by these differences?

5. What could have led these vaccines to be more affected than others?

6. Without the influence of COVID-19 outbreak what have been the strengths and weakness of the EPI programme with regard to service delivery?

7. What were the key challenges associated with the COVID 19 outbreak that were experienced with regards to the delivery of EPI services?

8. How has the suspension of EPI, the different stages of lockdown and the global stockouts influenced fluctuations in EPI coverage?

9. Has there been a difference in human resource utilisation for EPI services in comparison to the period before the emergence of the pandemic? Please explain

10. Has there been challenges with collection of EPI data after the emergence of COVID-19? Please explain

11. What key interventions did your province/ district put in place to ensure maintenance or improvement of EPI coverage during the COVID-19 period

12. What interventions would you recommend be put in place to ensure continuity of EPI services in future in the face of emergencies like COVID-19?

13. Are there any additional comments you would like to add with regards to access to EPI services?

Thank you very much for making time for this interview.

INTERVIEWER NOTES:

Appendix 2

Quantitative data entry sheet																								
EPI indicators	**March 2019 to February 2020**												**March 2020 to February 2021**											
	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb
BCG dose coverage																								
DTaP-IPV-HepB-Hib 3rd (Hexavalent) dose to Measles 1st dose drop-out																								
DTaP-IPV/Hib 1st dose coverage (annualised)																								
DTaP-IPV/Hib 3rd dose coverage (annualised)																								
DTaP-IPV/Hib 4th dose coverage (annualised)																								
HepB 3rd dose coverage (annualised)																								
Immunisation under 1-year coverage																								
Measles 1st dose under 1-year coverage																								
Measles 2nd dose coverage																								
OPV 1st dose under 1-year coverage																								
RV 2nd dose coverage																								
Td dose at 6 years coverage																								
Vitamin A dose 12-59 months coverage																								

Appendix 3

Exploring Uptake and Coverage of Expanded Program for Immunization (EPI) services among Children aged 0 to 12 months during the COVID-19 Pandemic in Free State Province, South Africa

CODING FRAMEWORK

BROAD CODE	Definition	FINE CODES	Definitions
Staff shortage	Number of nurses does not tally with the nurse patient ratio	Repurposed for COVID-19 intervention	
		Illness	
		COVID-19 infection of staff	
Remote facilities			
Rural districts			
Lockdown restrictions			
Low demand	People not coming in numbers	Fear of being infected at the facility	
		Movement challenges due to lockdown	
Stock outs	Some of vaccines out of stock	Logistical challenges	
		Global stockouts	

Appendix 4

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R49 Dr J Nyasulu

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M200706

NAME: (Principal Investigator)	Dr J Nyasulu
DEPARTMENT:	School of Clinical Medicine Department of Paediatrics and Child Health Division of Community Paediatrics Medical School University
PROJECT TITLE:	Maintaining essential services during the COVID-19 Pandemic: A call to strike the health systems balance in middle and low income countries (The South Africa and Malawi project)
DATE CONSIDERED:	2020/07/31
DECISION:	Approved unconditionally
CONDITIONS:	This approval covers Phases I and II only Phase III approval (Implementaion of the findings of Phases I and II) should be applied for separately All approvals apply only to South Africa
SUPERVISOR:	Not applicable
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2020/12/10

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

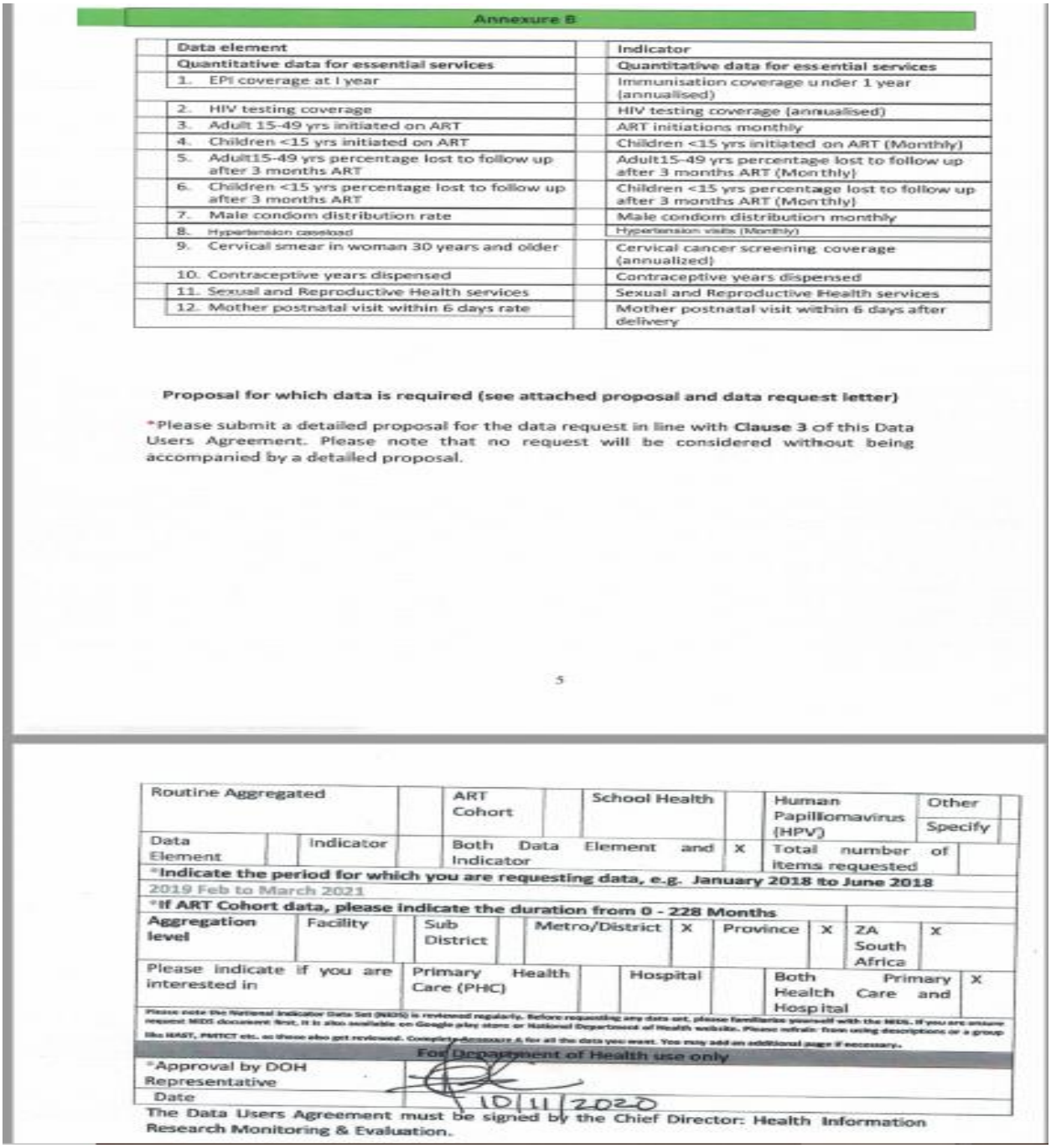
DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **July** and therefore reports and re-certification will be due in the month of **July** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator Date

Appendix 5



Annexure B

Data element	Indicator
Quantitative data for essential services	Quantitative data for essential services
1. EPI coverage at I year	Immunisation coverage under 1 year (annualised)
2. HIV testing coverage	HIV testing coverage (annualised)
3. Adult 15-49 yrs initiated on ART	ART initiations monthly
4. Children <15 yrs initiated on ART	Children <15 yrs initiated on ART (Monthly)
5. Adult15-49 yrs percentage lost to follow up after 3 months ART	Adult15-49 yrs percentage lost to follow up after 3 months ART (Monthly)
6. Children <15 yrs percentage lost to follow up after 3 months ART	Children <15 yrs percentage lost to follow up after 3 months ART (Monthly)
7. Male condom distribution rate	Male condom distribution monthly
8. Hypertension caseload	Hypertension visits (Monthly)
9. Cervical smear in woman 30 years and older	Cervical cancer screening coverage (annualized)
10. Contraceptive years dispensed	Contraceptive years dispensed
11. Sexual and Reproductive Health services	Sexual and Reproductive Health services
12. Mother postnatal visit within 6 days rate	Mother postnatal visit within 6 days after delivery

Proposal for which data is required (see attached proposal and data request letter)

*Please submit a detailed proposal for the data request in line with **Clause 3** of this Data Users Agreement. Please note that no request will be considered without being accompanied by a detailed proposal.

5

Routine Aggregated		ART Cohort		School Health		Human Papillomavirus (HPV)		Other Specify			
Data Element		Indicator		Both Data Element and Indicator	X	Total number of items requested					
*Indicate the period for which you are requesting data, e.g. January 2018 to June 2018											
2019 Feb to March 2021											
*If ART Cohort data, please indicate the duration from 0 - 228 Months											
Aggregation level	Facility		Sub District		Metro/District	X	Province	X	ZA South Africa	X	
Please indicate if you are interested in	Primary Health Care (PHC)		Hospital		Both Primary Health Care and Hospital	X					

Please note the National Indicator Data Set (NIDS) is reviewed regularly. Before requesting any data set, please familiarise yourself with the NIDS. If you are unsure request NIDS document first, it is also available on Google play store or National Department of Health website. Please refrain from using descriptions or a group like HAST, PMTCT etc., as these also get reviewed. Complete Annexure A for all the data you want. You may add an additional page if necessary.

For Department of Health use only

*Approval by DOH Representative	
Date	10/11/2020

The Data Users Agreement must be signed by the Chief Director: Health Information Research Monitoring & Evaluation.

Appendix 6

4/2/24, 4:35 PM Gmail - Student sub-study - Ethics approval Protocol# M200706

Nomvuyiseko Maduna <mvuyim@gmail.com>

Student sub-study - Ethics approval Protocol# M200706

Juliet Nyasulu <Juliet.Nyasulu@wits.ac.za> 11 May 2021 at 13:16
To: Iain Burns <Iain.Burns@wits.ac.za>
Cc: Zodwa Ndlovu <Zodwa.Ndlovu@wits.ac.za>, Nomvuyiseko Maduna <1911670@students.wits.ac.za>

Dear Mr Burns,

I would like to update you that I have attached am MPH PG student to my research project. The student will collect data on some of the study objectives in Free State Province. The MPH research Coordinator Dr Ndlovu has indicated that there is no need to apply for a separate Ethics approvals as per the newly revised policy. Below are the details.

Kindly note that I have requested the student to do a research ethics training and attached is the certificate.

Details of sub-study

Student name;	Nomvuyiseko Maduna
Student number;	**1911670**
Degree registered for;	MPH
Year first registered;	2018
Title of student project;	The uptake and coverage of Expanded Programme for Immunization (EPI) services among children aged 0 to 12 months during the COVID-19 pandemic in Free State Province, South Africa
Existing ethics clearance certificate number to be used for the student project;	M200706
Risk level (for non-medical human ethics clearance);	N/A
Approved student research proposal in PDF format .	Attached
Students Ethics training certificate	Attached

Kind regards

Dr. Juliet Nyasulu (MPH, PhD)