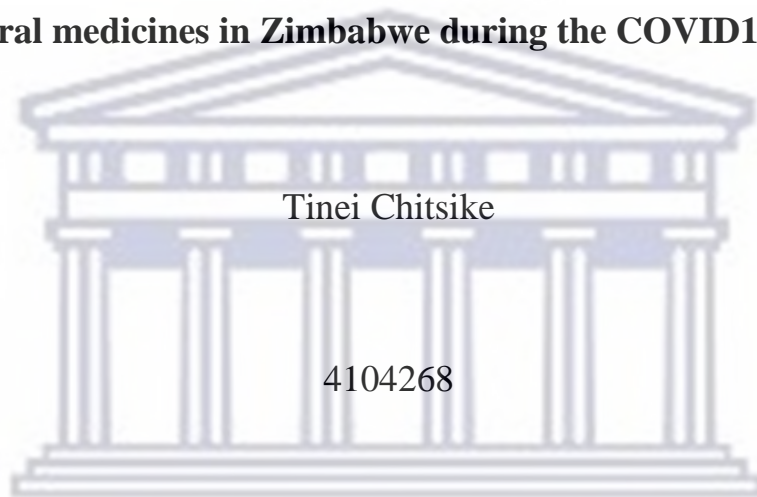


UNIVERSITY OF THE WESTERN CAPE

Faculty of Community and Health Sciences

**Exploring the experiences of supply chain managers involved in
antiretroviral medicines in Zimbabwe during the COVID19 pandemic.**



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A mini thesis submitted in partial fulfilment of the requirements for the degree
of Master of Public Health at the School of Public Health, University of the
Western Cape.

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Keywords

ARVs

COVID19

Logistics

Procurement

Public health

Supply chain

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Abstract

Background: HIV and AIDS remain a major public health problem globally, in sub-Saharan Africa and particularly in Zimbabwe. The efficient supply of medicines, including Anti-Retroviral (ARVs), is essential to HIV treatment and care during a public health emergency. The COVID19 pandemic exposed vulnerabilities within public health supply chains that manifested in shortages of medicines, medical supplies, and equipment.

Aim and objectives: This study explored the experiences of supply chain managers involved in managing ARVs in Zimbabwe during the COVID19 pandemic. It describes the successes, challenges and lessons learnt in managing ARV supply chains in Zimbabwe during the pandemic.

Methodology: This was an exploratory, descriptive, qualitative study. In-depth interviews were conducted on a heterogenous, purposively selected sample of ten supply chain managers drawn from Ministry of Health and Child Care (MoHCC) and health development partners involved in forecasting, supply planning, procurement, warehousing, and distribution of ARVs in Zimbabwe. Only central and provincial level supply chain managers were included in the study, given the limited scope, time frame and resources available for the research. The interviews were conducted on Microsoft Teams using a semi-structured interview guide. Audio recordings of interviews were transcribed before the data was coded and analysed. Manual thematic coding was used for data analysis which involved assigning codes and identification of emerging and global themes. Data was consolidated and interpreted giving rise to meanings, explanations, and conclusions around the data in relation to the research question.

Ethics: Ethical approval was obtained from UWC BMREC (Reference BM23/10/31) and the Medical Research Council of Zimbabwe (Reference MRCZ/B/2630). Ethical risks were minimised by ensuring informed consent, confidentiality and voluntary participation. Data was collected, stored, and processed in accordance with the requirements of the Protection of Personal Information Act (Act 4 of 2013) and the data management plan.

Results: The study revealed wide-ranging upstream and downstream disruptions and vulnerabilities in the ARV supply chain during the COVID19 pandemic across six thematic

areas; health supply chain leadership, management, financing, partnership and coordination; forecasting and supply planning; procurement; logistics management information systems, data management, reporting and ordering; inventory management and control including storage & distribution; and supply chain performance, last mile availability, access to and dispensing of ARVs. Challenges experienced by the supply chain managers included lockdown, travel restrictions, temporary closure of health facilities, manufacturing delays, shipment delays, shipping cost escalation, local warehousing and distribution constraints that affected last mile availability and access to ARVs. However, despite these challenges, the study showed successes and innovative strategies brought about or amplified by the pandemic such as improved coordination and communication among key stakeholders; timely processing of import waivers; streamlined customs clearance process; functional system for data management, reporting and ordering and adequate buffer stock that minimised supply disruption. Supply chain managers reported that ARVs remained generally available at service delivery points without significant interruption to treatment. There were lessons learnt from the COVID19 pandemic that inform supply chain recommendations and adjustments needed to mitigate the negative impact of future pandemics. These include the need for; improved communication, coordination and partnership among key stakeholders; protecting the health supply chain workforce; automating supply chain processes; agility, innovation, adaptability and change management in the supply chain; as well as adopting differentiated, client centred service delivery models.

Conclusion: The study demonstrated both strengths and vulnerabilities in the Zimbabwe ARVs supply chain system that were amplified by the COVID19 pandemic. The disruptions and vulnerabilities uncovered by this study highlight the need to strengthen health supply chain systems to make them more resilient to pandemic shocks. Resilience strategies should be part of an intentional plan rather than an afterthought. Key recommendations drawn from the study findings that are relevant to public health supply chain policy makers, funders and operators during future pandemics and related emergencies include: long-term forecasting and supply planning; supplier collaboration for better production planning and order fulfilment; local or regional manufacturing; prepositioning stock at local and regional warehouses; establishing long term agreements with key suppliers; improved data visibility and analytics; surge capacity for warehousing and transport; and framework contracts for outsourcing supply chain services when needed.

Declaration

I declare that “Exploring the experiences of supply chain managers involved in antiretroviral medicines in Zimbabwe during the COVID19 pandemic” is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

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Date: 11 November 2024

Signed: 

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Acronyms

AIDS	Acquired Immune Deficiency Syndrome
API	Active Pharmaceutical Ingredient
ART	Anti-Retroviral Therapy
ARV	Anti-Retroviral
BMREC	Biomedical Research Ethics Committee
CBCA	Consignment-Based Conformity Assessment
COVID19	Coronavirus
DPS	Directorate of Pharmacy Services
DSD	Differentiated Service Delivery
ERP	Enterprise Resource Planning
GHSC-PSM	Global Health Supply Chain – Procurement and Supply Management
GoZ	Government of Zimbabwe
HIV	Human Immune Virus
HMIS	Health Management Information System
ICT	Information Communication Technology
LMIS	Logistics Management Information System
MCAZ	Medicines Control Authority of Zimbabwe
MMD	Multi-Month Dispensing
MRCZ	Medical Research Council of Zimbabwe
MoHCC	Ministry of Health and Child Care
NATF	National AIDS Trust Fund
NatPharm	National Pharmaceutical Company
NFM	New Funding Mechanism
OIG	Office of the Inspector General
PEPFAR	President's Emergency Plan for AIDS Relief
PLHIV	People Living With HIV
PMD	Provincial Medical Directorate
PMTCT	Prevention of Mother to Child Transmission
POPIA	Protection of Personal Information Act
PPE	Personal Protective Equipment
PPM	Pooled Procurement Mechanism
PSM	Procurement and Supply Management

QAT	Quantification Analytics Tool
SADC	Southern African Development Community
TB	Tuberculosis
TLE	Tenofovir/Lamivudine/Efavirenz
TLD	Tenofovir/Lamivudine/Dolutegravir
UN	United Nations
UNAIDS	United Nations Programme on HIV/AIDS
UNDP	United Nations Development program
UNICEF	United Nations Children's Fund
UWC	University of the Western Cape
WHO	World Health Organization
ZADS	Zimbabwe ARVs Distribution System
ZAPS	Zimbabwe Assisted Pull System
ZIMPHIA	Zimbabwe Population-based HIV Impact Assessment
ZIMRA	Zimbabwe Revenue Authority
ZISHAC	Zimbabwe Information System for HIV AIDS Commodities

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Chapter 1: Introduction

1.1 Background

The continuity of essential health services such as those provided by national Human Immune Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS), tuberculosis (TB), malaria, reproductive health, maternal, newborn and child health programmes is critical, including during a public health emergency like Coronavirus (COVID19). Likewise, the effective and efficient supply of health commodities such as medicines and medical supplies is critical to the successful delivery of essential services, including antiretroviral therapy (ART) which is of relevance to Zimbabwe. It follows that shifting the focus of the public health system towards pandemic response at the expense of essential health services can potentially lead to a public health catastrophe.

HIV and AIDS remains a major public health challenge globally, and in sub-Saharan Africa including Zimbabwe. According to United Nations Program on HIV/AIDS (UNAIDS) estimates, 38.4 million people globally were living with HIV in 2021 (Joint United Nations Programme on HIV/AIDS, 2022). The United Nations (UN) estimates that as at the end of December 2021, 28.7 million people were accessing antiretroviral therapy globally. In East and Southern Africa, an estimated 20.6 million people were living with HIV with 16.2 million (78%) accessing treatment (United Nations Programme on HIV/AIDS, 2022). A 2020, population-based household survey in Zimbabwe showed that the annual incidence of HIV among adults aged 15 years and older was 0.38% with HIV prevalence at 12.9% (Ministry of Health and Child Care, 2020). Viral load suppression among all adults living with HIV in Zimbabwe was 77.3 (Ministry of Health and Child Care, 2020). These statistics are evidence of the burden of HIV and AIDS, globally, in sub-Saharan Africa and Zimbabwe as well as the critical role of anti-retroviral therapy in ensuring viral suppression and epidemic control.

Strong and resilient public health supply chains that ensure uninterrupted supply of quality assured antiretroviral medicines are vital to the success of the HIV and AIDS prevention, treatment, and care programme in Zimbabwe. The successes of the Zimbabwe public sector antiretroviral therapy (ART) programme can be attributed to such a strong and resilient supply chain operated by the Government of Zimbabwe (GoZ) with strong financial and

technical assistance from multilateral and bilateral partners such as the Global Fund and the United States Presidents Emergency Plan for AIDS Relief (United Nations Children’s Fund, 2018; PEPFAR Zimbabwe, 2020). The Coronavirus (COVID19) pandemic posed serious supply chain challenges that threatened years of success of the ART programme in Zimbabwe. The effects of interrupted supply of ARVs can be potentially catastrophic. These range from development of HIV drug resistance, treatment failure, low viral load suppression, increase in new infections, increased risk of opportunistic infections and preventable mortality (Jewell *et al*, 2020; Guaraldi *et al*, 2021; Dorward *et al*, 2021)). An understanding of how and why COVID19 affected supply of ARVs in Zimbabwe is imperative to implementing mitigation strategies during future pandemics.

1.2 Study setting

Zimbabwe is a low-income country in sub-Saharan Africa with the majority of the estimated 13 million population relying on public health services. Zimbabwe implements a tiered, decentralised, primary healthcare system. Like many developing countries in sub-Saharan Africa, Zimbabwe has a high burden of infectious diseases including HIV that contribute significantly to poverty, human suffering, morbidity and mortality (United Nations Programme on HIV/AIDS, 2022).

The HIV and AIDS Program in Zimbabwe is managed by the Ministry of Health and Child Care (MoHCC). The HIV and AIDS Directorate within MoHCC coordinates the efforts of various government, private, faith based, and non-governmental organisations involved in implementing the ART programme in Zimbabwe. The MoHCC Directorate of Pharmacy Services is responsible for ensuring the provision of quality, affordable and equitable medicines (including ARVs), and medical supplies in the Zimbabwe public health sector.

The Medicines Control Authority of Zimbabwe (MCAZ) is the medicines regulatory authority mandated to regulate the supply and use as well as ensure the quality, safety, and efficacy of medicines (including ARVs) and medical products and devices including in-vitro diagnostics in Zimbabwe. The National Pharmaceutical Company (NatPharm), formerly Government Medical Stores, is a government owned, commercialised entity responsible for procurement, warehousing and distribution of medicines and medical supplies in Zimbabwe.

NatPharm operates a network of six regional and provincial warehouses that supply ARVs to about 1,600 health facilities spread across ten provinces and sixty-four districts.

The Government of Zimbabwe (GoZ) provides funding generated through the AIDS levy for ARVs procurement and supply chain management. Various health development partners operate in the country providing funding and implementation support to the MoHCC. The Global Fund and PEPFAR provide funding support to the GoZ for procurement and supply management of ARVs to Zimbabwe. The United Nations Development Program (UNDP), the Global Health Supply Chain – Procurement and Supply Management (GHSC-PSM) program managed by Chemonics International and NatPharm manage ARVs procurement and supply management funded by the Global Fund, PEPFAR and GoZ respectively.

The MoHCC provincial directorates and district health structures have responsibility for local supervision and monitoring and provision of healthcare services in health facilities within their jurisdiction. Antiretroviral medicines are dispensed to clients at central, provincial, district and mission hospitals, health centres and clinics throughout the country. Various differentiated service delivery models including community outreach, community ART refill groups and peer to peer models provide access to ART medicines and adherence counselling services at community level to increase access coverage and retention in care (Apollo *et al*, 2018).

1.3 Problem statement

The effective and efficient supply of medicines and medical supplies, including ARVs, is essential to the provision of HIV treatment and care, including during a public health emergency. The COVID19 pandemic exposed vulnerabilities within public health supply chains globally that manifested in shortages of medicines, medical supplies, and equipment in all countries, including Zimbabwe. Whilst a systematic review of existing research on the COVID19 pandemic identified literature on the COVID19 impact on supply chains and strategies for supply chain resilience, recovery, and sustainability in the light of the pandemic (Chowdhury *et al*, 2021), most studies were conducted in Europe, Asia, and the Americas, with very few in Africa. In addition, most literature covered supply chain with a general scope across different economic sectors, mostly on fast moving consumer goods, and few studies have been conducted in healthcare and social sciences (Chowdhury *et al*, 2021).

There have been limited studies on the supply chain experiences managing ARVs in Zimbabwe during the COVID19 pandemic (United Nations Children’s Fund, 2020; Nyashanu *et al*, 2021; Munharo *et al*, 2021; The Global Fund, 2021). The proposed research will explore the successes, challenges and lessons learnt in managing health supply chains during the COVID19 pandemic in the context of the ART programme in Zimbabwe based on real world experiences of practicing supply chain managers. It will inform best practices for managing health supply chains during future COVID19 and related pandemics in Zimbabwe and similar settings.

1.4 Aim

To explore the experiences of supply chain managers involved the management of the ARVs supply chain in Zimbabwe during the COVID19 pandemic.

1.5 Objectives

- To describe and explain the successes in managing supply chains for ARVs in Zimbabwe during the COVID19 pandemic.
- To describe and explain the challenges in managing supply chains for ARVs in Zimbabwe during the COVID19 pandemic.
- To describe the lessons learnt in managing supply chains for ARVs in Zimbabwe during the COVID19 pandemic.

The burden of HIV and AIDS poses major public health challenges globally, in sub-Saharan Africa including in Zimbabwe. Uninterrupted supply of ARVs is critical to mitigating the impact of HIV and AIDS on the population. The COVID19 pandemic exposed vulnerabilities in public health supply chains that threatened the delivery of essential health services provided through the national ART programme in Zimbabwe. The following chapters will cover literature review, methods, results, discussion, conclusions and recommendations.

Chapter 2: Literature review

2.1 Introduction

The following section will review available literature on the COVID19 impact on HIV and AIDS Programmes healthcare supply chains in general and specifically ARV supply chains. It explores available literature first from a global perspective, then regional and finally at local level, in the Zimbabwe context. Furthermore, the review covers the challenges brought about by the COVID19 pandemic, and the changes and strategies implemented to minimize the impact of the pandemic on HIV and AIDS programmes, supply chains and delivery of antiretroviral therapy (ART) services.

2.2 COVID19 impact on HIV and AIDS programmes

The emergence and spread of COVID19 posed difficulties in HIV and AIDS prevention, treatment and care programmes. COVID19 caused the diversion of resources from routine services and programmes such as malaria, tuberculosis, HIV and AIDS (Chanda-Kapata *et al*, 2022). Lockdowns, COVID19 prevention measures, lack of public transport, missed clinic appointments, health workforce shortages, repurposing and closure of health facilities were experienced in many countries (Chanda-Kapata *et al*, 2022).

The COVID19 pandemic caused significant changes in the health system, affecting HIV prevention services such adult HIV testing, early infant diagnosis, counselling, voluntary medical male circumcision (VMMC), pre-exposure prophylaxis (PrEP) and prevention of mother to child transmission (PMTCT) of HIV (Guaraldi *et al*, 2021). Likewise, treatment and care interventions were negatively affected including clinical review, viral load testing, adherence counselling, antiretroviral therapy initiation, ART resupply, treatment and care for opportunistic infections and other advanced HIV conditions (Guaraldi *et al*, 2021; Muhula *et al*, 2021; Dorward *et al*, 2021). The full impact of the COVID19 pandemic on country and global HIV and AIDS programmes has not been determined. Available literature is based on estimates from mathematical modelling (Jewell *et al*, 2020), however, it has been stated that the pandemic has stalled progress towards the United Nations Programme on HIV/AIDS 90:90:90 goals for testing, treatment and viral suppression (Guaraldi *et al*, 2021).

The impact of COVID19 on HIV and AIDS programming called for concerted efforts by national governments, international and local organisations to minimise impact particularly on weak health systems in resource limited settings (Aborode *et al*, 2021). To mitigate the resource gaps, additional commitments and investments were needed from government, the private sector, multilateral and bilateral organisations to strengthen routine services and build resilient, sustainable health systems in the context of the pandemic. Apart from regular domestic and external financing, additional investments were made through the Global Fund COVID19 Response Mechanism (CRM) and the American Rescue Plan Act (ARPA) to mitigate the impact of COVID19 on HIV AIDS programmes (Holtzman *et al*, 2022).

2.3 COVID19 impact on healthcare supply chains

The coronavirus (COVID19) pandemic brought new supply chain management complications that managers had to deal with, such as the COVID19 pandemic induced lockdowns which posed varying risks to global and local supply chains (Guan *et al*, 2020). The lockdowns had direct and indirect impacts on the supply of raw materials, manufacturing operations, global freight and logistics capabilities across different economic sectors including the medical and pharmaceutical industry. Mahmoodi *et al* (2021) documented how the pandemic exposed numerous and major supply chain weaknesses that manifested through shortages of personal protective equipment (PPE) and testing kits.

The world largely depends on China and India for the manufacture and supply of raw materials and finished products, particularly in the pharmaceutical, medical equipment and supplies category. The rise of COVID19 infections in China and India severely diminished the two countries' ability to provide supplies to satisfy local and global demand for essential medicines, medical supplies, and equipment. Okafor *et al* (2021) documented COVID19 pandemic induced disruptions to national and international supply chains for medical devices, essential medicines, and pharmaceutical products due to border closures, transportation bottlenecks, and international trade restrictions.

Furthermore, during the pandemic itself countries such as China, India and the United States of America imposed temporary restrictions on the export of medical equipment, diagnostics, medicines, and medical supplies. Among the products that faced restrictions were ventilators, COVID19 rapid test kits and personal protective equipment such as gloves (Sharma *et al*,

2020; Mahmoodi *et al*, 2021). Sharma *et al* (2020) documented the health supply chain disruptions in India, their root causes and mitigation measures. Apart from supply side issues, escalating demand, hoarding and irrational use of critical health products such as gloves, N95 masks, ventilators, and oxygen concentrators worsened the situation (Sharma *et al*, 2020).

2.4 COVID19 pandemic impact on global and regional supply of ARVs

The following section explores the literature on the impact of the COVID19 impact on the global and regional supply of ARVs, focussing on the challenges and mitigation strategies. It will be followed by literature review on specific experiences from Zimbabwe.

2.4.1 The challenges

A 2020 survey by the UNAIDS revealed several manufacturing and logistics challenges caused by lockdowns that affected generic ARV manufacturers in six countries that represent 80% of global generic ARVs production (United Nations Programme on HIV/AIDS, 2020). Manufacturing capacity for active pharmaceutical ingredients (APIs) and formulated ARVs in China and India went down by 30% in 2020, a significant reduction induced by lockdown related workforce challenges, packaging shortages and curtailment of border and port operations (Holtzman *et al*, 2022). In their report, UNAIDS made some recommendations for countries to identify the risk level across all product lines, coordinate action to streamline supply chains as well as open and timely communication between procurement entities and suppliers (United Nations Programme on HIV/AIDS, 2020).

A 2020 snapshot survey carried out by the Global Fund at more than 500 health facilities in over 30 African and Asian countries showed a decline in HIV prevention service delivery, including HIV testing and Prevention of Mother to Child Transmission (PMTCT) of HIV (The Global Fund, 2020). Similarly, a systematic review of several studies illustrated the negative impact of COVID19 on HIV programmes including provision of clinical services and ARVs for ART and pre-exposure prophylaxis (Mirzaei *et al*, 2022).

A cross-sectional health facility data-based survey across 27 health facilities in Anambra State, in Nigeria during the COVID19 pandemic revealed that although the main first line adult ARV were widely available, there were several instances of emergency orders, stockouts and losses of ARVs and HIV rapid test kits (Nweke *et al*, 2023). In Kenya, clients

reported treatment interruption due to self-isolation, lockdown measures and health facility closure (Muhula *et al*, 2021). A study by Dorward *et al* (2021) on impact of the 2020 national COVID19 lockdown on HIV testing and treatment in KwaZulu-Natal, South Africa showed that ART provision was generally maintained during the 2020 COVID19 lockdown, but HIV testing, and antiretroviral therapy (ART) initiations were heavily impacted.

Maintaining a consistent supply of ARVs should be an integral part of an integrated response to the dual pandemic of COVID19 and HIV. Novel and nimble approaches to differentiated service delivery are also required to maximise efficiencies and return on investment in healthcare. The challenges described above point to the need to invest in designing and implementing agile and resilient supply chains that ensure minimal interruption to provision of essential health products during pandemics.

2.4.2 Mitigation strategies

Strategies to minimize non-essential visits to health facilities and ensure continuity of ARVs supply and treatment were recommended and adopted in several countries including in Ethiopia (GHSC-PSM, 2021). Coping strategies and tactics deployed in PEPFAR-supported countries included reforecasting, renegotiation of delivery timelines, review of dispensing protocols, and distribution and use of buffer stock (Holtzman *et al*, 2022). Coordinated service delivery and supply chain innovations such advanced analytics, data-based decision making, accurate forecasting, end to end supply chain integration, supplier collaboration and agile management allowed the successful rollout and uptake of optimised dolutegravir based regimens despite the challenges of the COVID19 pandemic (Golin *et al*, 2023). In PEPFAR supported countries, the number of sites offering multi-month dispensing (MMD) and the number of clients receiving MMD almost doubled between 2019 and 2020 (Holtzman *et al*, 2022). Multi-month dispensing was also implemented as a coping strategy in Nigeria (The Global Fund, 2020). Several countries in Africa adopted community approaches to ART distribution including community ART dispensing points, mobile clinics and home delivery (Uwishema *et al*, 2022).

Systematic reviews of several studies documented mitigation measures including multi-month dispensing, telemedicine and protection of health workforce through use of personal protective equipment and COVID19 vaccination (Mirzaei *et al*, 2022). In Tanzania similar observations and recommendations were made related to disruption of prevention, treatment

and care services and mitigation measures deployed such as multi-month dispensing, telehealth and decentralised models for medicine distribution (Mwanja *et al*, 2024). Home delivery was successfully used as a model for delivering ARVs to clients to mitigate effects of COVID19 in several south-east Asian countries (Hoke *et al*, 2021). In China, mailing services, community-based organisations and out of pocket purchases of ART from medicine vendors was successfully adopted (Lal *et al*, 2022). All these strategies need to be explored, tested, adopted and scaled to ensure continued access and adherence to ART under difficult conditions posed by pandemics and other public health emergencies

2.5 COVID19 impact on health supply chain in Zimbabwe

Like in the rest of the world, COVID19 brought some changes to the health system and supply chain in Zimbabwe. Real-time monthly surveillance of tuberculosis (TB) and HIV activities in ten health facilities in Harare showed a decrease in testing of TB suspects, case notification, treatment enrolment and success rates (Thekkur *et al*, 2021). In the same study, linkage of TB to antiretroviral therapy decreased from 95.7% to 91.7%. Health supply chain workers perspectives on whether inadequate supply of ARVs contributed to decreased service delivery including linkage to ART initiation or treatment interruption were not included in the study.

A rapid survey supported by the United Nations Children's Fund (UNICEF) at the onset of the COVID19 pandemic in Zimbabwe showed that access to health services was limited due to travel restrictions, lack of transport and suspension of home visits (United Nations Children's Fund, 2020). It also showed that most people living with HIV had adequate supplies of ARVs, but lockdowns threatened delivery of other essential health services such as ante-natal care visits, Prevention of Mother to Child Transmission (PTMCT) appointments, ART consultations and medicine refills (United Nations Children's Fund, 2020). However, a study by Nyashanu *et al* (2021) in a peri-urban area of Harare during the COVID19 pandemic lockdown reported limited supplies of ARVs at health facilities. An assessment of the impact of COVID19 on medicines procurement, supply chain management and pricing in Zimbabwe revealed the changes brought about by the COVID19 pandemic worsened pre-existing challenges of limited funding, foreign currency shortages, price volatility, import and export restrictions (Yemeke *et al*, 2023).

Research carried out in Zimbabwe by Munharo *et al* (2021) looked at the COVID19 impact on health supply chains in general and did not focus on vertical programmes. They reported that, “COVID19 has disrupted the health sector supply chain greatly and this has incurred detrimental effects of untimely deaths of patients and enormous challenges for health workers” (Munharo *et al*, 2021). Although clients’, including people living with HIV and caregivers’ and civil society experiences around this subject have been documented, health supply chain managers’ perspectives are glaringly missing. The narrative of a dire situation could be potentially unbalanced given the level of activism around supply issues in HIV treatment and care service delivery.

In conclusion, this literature review documents changes in health services delivery and supply chains brought about by the pandemic at global, regional and local level. It also describes the mitigation measures recommended and supported by global funding and implementing agencies that were adopted or adapted by countries into their local programmes. Despite the available global and regional evidence base, specific literature on the interaction of COVID19 and ARVs supply chains in Zimbabwe is limited. The proposed research will contribute to the body of knowledge on the successes, challenges and lessons learnt in the management of ARVs supply chains during the COVID19 pandemic in Zimbabwe based on real world experiences of practicing managers. In addition, it will inform best practices and recommendations for managing health supply chains during future COVID19 and related pandemics in the context of Zimbabwe’s vertical health programmes

Chapter 3: Research design and methodology

3.1 Study design

This study took the form of an exploratory, descriptive qualitative design. In-depth interviews were conducted with ten study participants using a semi-structured interview guide (Appendix A). The in-depth interviews were conducted in English as all participants were proficient in English and use this as their language of training and work. In-depth interviews were appropriate for this exploratory study because it allowed study participants to freely express their experiences, views, feelings, and perspectives. The in-depth interviews elicited a clear understanding of the intricate issues around the successes, challenges and lessons learnt in supply chain management of antiretrovirals (ARVs) in Zimbabwe during the COVID19 pandemic.

3.2 Study population

The study population consisted of over one hundred health supply chain practitioners involved in supply chain management of ARV medicines in the Zimbabwe public sector antiretroviral therapy (ART) program. It consisted of staff working on various supply chain functions such as product selection, regulation, forecasting, supply planning, procurement, warehousing, and distribution from manufacturers and wholesalers down to health facility level. The study population comprised different professionals such as pharmacists, pharmacy technicians, logisticians, regulators, nurses, and allied health professionals such as nurse aides and dispensary assistants. A number of institutions such as the Ministry of Health and Child Care (MoHCC) Directorate of Pharmacy Services (DPS), Provincial Medical Directorates (PMD), National Pharmaceutical Company (NatPharm), United Nations agencies and health development partners who manage and provide support for procurement and supply management of ARVs in Zimbabwe.

3.3 Study sample

The study sample consisted of a heterogenous, non-probability, purposively selected sample of ten supply chain managers drawn from MoHCC and health development partners involved in product selection, regulation, forecasting, supply planning, procurement, warehousing, and distribution of ARVs. The sample of central and provincial level staff involved in management of different supply chain functions ensured that a diversity of viewpoints was captured.

3.4 Data collection

Data was collected from central and provincial level supply chain managers only given the limited scope, time frame and resources available for this research. In-depth interviews were conducted using a semi-structured interview guide (Appendix A). The interviews were conducted virtually on Microsoft Teams. Informed consent was obtained in writing from participants to participate in the interviews and to take audio recordings of interviews. Although face to face in-depth interviews provide a rich form of data including non-verbal cues from the physical interaction between the interviewer and respondent, they were not used because of distance, time and cost constraints. In-depth interviews were arranged in advance through phone calls, e-mail, and WhatsApp contact, booked online and appointment links were shared. Participants were reminded of the interview appointments and asked to confirm attendance at least twenty-four hours in advance. Interviews lasted between forty-five minutes and one hour.

3.5 Data analysis

Audio recordings of interviews were transcribed before the data was coded and analysed. Manual thematic coding was used based on the approach by Kielmann *et al* (2011). The analysis process involved data transcription, assigning codes and identification of emerging themes. This involved reading through the transcribed text and listening to the recordings several times to familiarize with the data, identifying key concepts or ideas and assigning codes. Coded data was organized into emerging themes that represent data with the same meaning. Emerging themes were reviewed for relationships and organised into global themes making sure there was consistency and coherence of meaning within each global theme by reallocating emerging themes between global themes.

The final step in data analysis was the integration and interpretation of the data in summary tables and narratives supported by quotes from interviews, thus giving rise to meanings, explanations, and conclusion around the data in relation to the research question. All the data collected was analysed and reflected in the analysis while ensuring that there was no inadvertent misinterpretation of meaning of data due to omission. The conclusion and recommendations were derived through an iterative process of re-engaging with the data. The analysis presented in this study draws points of argument for and against the conclusions from other research studies.

3.6 Rigor

Rigor was built into the study process. Attention to rigor in the study ensured quality by being intentionally careful, thorough, consistent, objective, accurate and precise in the research process. Rigor and validity are as important in qualitative health research as in quantitative health research. Cresswell and Miller (2000), identify four basic criteria for rigor: trustworthiness, transferability, reliability, and verifiability. For this study, the researcher applied several strategies during preparation, sampling, data collection, analysis, and interpretation stages to ensure rigor.

The researcher was familiar with the research environment. Deliberate effort was made to ensure that the sample represented the population and that no perspectives, views, and practices were overlooked. Constant reference to the research problem ensured design coherence, and that aims, objectives, methods of data collection and analysis addressed and were linked to the research problem. The approach taken was consistent with that proposed by Malterud (2001) who asserts that research integrity entails questioning findings, interpretations, linking results to the study aim, understanding the context and researcher biases, and transparency of data display and analysis. The sampling methodology clearly defined criteria for recruitment and selection of study participants. Only participants who are familiar with the subject matter were interviewed to mitigate eliciting erroneous and off-context responses.

Original data in the form of audio and video recordings of in-depth interviews and transcripts were retained and filed for transparency and future verification. The research findings and interpretations were compared or triangulated to those drawn from other settings to check external validity. Reflexivity was exercised to ensure self-awareness and to reflect on the researcher's role in the research process and acknowledging researcher biases related to their employment, personal relationships, professional connections, work and institutional history and vested interest in the study setting. The researcher's theoretical position, background, current scope of practice and funding were declared to mitigate any real or perceived conflict of interests and views.

Existing literature was reviewed before and during the study, drawing comparisons of what is already known, the findings and knowledge gaps. The limitations and weaknesses of the study were also declared. Compliance with protocol and ethical standards, record keeping

and continuous reference to literature were key strategies for ensuring rigor in this research as advocated by Fathalla (2004). Study assumptions and recommendations for further research where gaps are identified were declared.

3.7 Ethics

Ethical approval was obtained from University of the Western Cape Bio-Medical Research Ethics Committee (Reference number BM23/10/31, Appendix B) and the Medical Research Council of Zimbabwe (Reference number MRCZ/B/2630, Appendix C). Potential ethical risks associated with the study were identified. Ethical risks were assessed, and measures were taken to mitigate the risks as described below. Adequate information was provided to research study participants to make sure they understood the purpose, expectations, risks, and benefits of participating in the study. The information was provided through a written participant information sheet in the language understood by the participants (Appendix D). This information was also explained fully to each participant before the interview.

All participants were requested to provide voluntary consent to participate in this research study, understanding that they were under no obligation to participate. This was achieved through a written informed consent form that was explained to and voluntarily signed by participants prior to participating in the in-depth interviews (Appendix E). The informed consent forms were written and explained in a language that the participants understood. Participants had the right to withdraw from the research at any time without the need to explain the reason for withdrawal.

To protect the participants, confidentiality of information provided was maintained by not disclosing the information to anyone. Written as well as audio and video recordings of the information provided were password protected during and after the research study. Data was collected, stored and processed in accordance with the data management plan (Appendix F). Records will be kept for five years after which they will be destroyed. Participants were guaranteed anonymity hence the information collected is not personally identifiable. All personal information was collected, stored and processed in accordance with the requirements of the Protection of Personal Information Act (Act 4 of 2013). The researchers have declared no conflict of interest and undertake to declare and mitigate any real or perceived conflict of interest that may arise.

Chapter 4: Results

4.1 Introduction

This chapter presents the findings of the study in which ten supply chain managers involved in the Zimbabwe public sector antiretrovirals (ARVs) supply chain at central and provincial level shared their experiences in managing the ARV supply chain during the Coronavirus Disease (COVID19) pandemic. The study participants provided insights on their experiences during the pandemic across the different supply chain functions, drawing comparisons between the period before and during the pandemic. Respondents shared their personal and professional experiences as well as their perception of the experiences of their clients and the broader community.

The study participants included procurement, logistics and pharmacy professionals working for government departments and implementing partners supporting various functions of the supply chain at central and province level including product selection, resource mobilisation, forecasting, supply planning, procurement, storage, distribution, data management, coordination and monitoring. Four of the respondents worked at provincial level, five at central level and one changed role between provincial and central level during the pandemic. Two respondents were female and eight were male. To preserve anonymity, quotations from respondents will only be identified in this chapter by the level at which they work in the health system.

The findings of the study were grouped into six main thematic areas:

- health supply chain leadership, management, financing, partnership and coordination
- forecasting and supply planning
- procurement
- logistics management information systems, data management, reporting and ordering
- inventory management and control including storage & distribution and
- supply chain performance, last mile availability, access to and dispensing of ARVs

In each of these thematic areas the experiences of the ARV supply chain managers were organised into successes or achievements, challenges or failures and lessons learnt, or innovations. Overall, the study found that experiences were relatively consistent across respondents with isolated differences depending on respondents' scope of work, level within

the supply chain, location, attitude, personal and organisational arrangements. As expected, more of the experiences brought about by the pandemic were related to challenges rather than successes, hence for each of the main thematic areas, the results section will begin by describing the challenges, then successes and finally describe the lessons learnt.

4.2 Health supply chain leadership, management, financing, partnership and coordination

The first thematic area identified included health supply chain leadership, management, financing, partnership and coordination. Table 1 shows the themes that emerged in this thematic area, organised into challenges, successes and lessons learnt.

Table 1: Emerging themes in health system, supply chain leadership, management, financing, partnership and coordination

Thematic area	Emerging Themes		
	Challenges	Successes	Lessons learnt
Health system, supply chain leadership, management, financing, partnership and coordination	<ul style="list-style-type: none"> • Lockdown • Emotional strain • Infections among staff • Shutdown of health facilities and “non-essential services” • Social distancing, and shift work • Routine monitoring, supportive supervision visits suspended 	<ul style="list-style-type: none"> • Designation of MoHCC, NatPharm and health development partners as essential services • Dedicated transport for health workers • Biweekly supply chain meetings with stakeholders • Coordination between programs, supply chain, partners and people lining with HIV (PLHIV) • Distribution planning meetings 	<ul style="list-style-type: none"> • Effective communication, coordination and partnership • Leveraging technology to mitigate human interaction • Building resilience into supply chain system design • Domestic financing • Pandemic preparedness • Build capacity in emergency supply chain • Continuity of essential services • Services and supply chain integration • Adaptability and innovation • Supply chain sustainability

4.2.1 Challenges in health system, supply chain leadership, management, financing, partnership and coordination

Most supply chain managers interviewed lamented the panic and travel restrictions implemented at the beginning of the pandemic as part of the COVID19 prevention measures. The measures affected the ability of health supply chain workforce and clinical staff to report for work despite health workers having been designated as essential services providers eligible for travel exemption. As one of the respondents said:

“I mean, there was panic, there was panic at almost every level, administrative level, Ministry of Health, head office, provincial level. Then you know instructions came through to say can you close non-essential departments? Only the casualty departments would be open”. (Provincial)

Supply chain managers described how the pandemic shocked the health system and shifted the attention of Ministry of Health from routine health service delivery to pandemic response. The situation caused emotional strain on the health supply chain workforce and their clients, some of whom were affected and infected with COVID19. One supply chain manager described how the period was strenuous, overwhelming and at times quite stressful:

“Since I had to take responsibility for everything, when my colleagues in the pharmacy could not make it to work, or when they felt unwell or for any other reasons, I had to take up their roles as well and be always there. So yeah, it was. It was quite strenuous, overwhelming at times and yes, it was quite a stressful phase and yeah, but I had to show up and make sure our clients, the ones that were able to come, they received their medicines without any interruption of service”. (Provincial)

Some provincial health directorates issued a directive to hospitals to close what were non-essential departments, designating only casualty or emergency department, maternity and theatre as essential. The focus of the national, provincial and district health management teams was on distributing personal protective equipment (PPE), medicines for COVID19, case management and equipment for COVID19 isolation centres such as beds, oxygen support and multiparameter monitors.

Supply chain managers reported that some clinics closed operations temporarily as staff were infected and affected with COVID19. As a result of health facility closures, clients and communities could not access health facilities for a limited period. Health workers were instructed to practise social distancing as part of COVID19 prevention measures hence staff had to rotate work shifts and report for duty two or three days per week. Pharmacy departments and opportunistic infection clinics that dispensed ARVs were not spared. Health workers providing clinical care and managing medicines supply reduced the number of days they reported for work thus affecting ordering, distribution and dispensing of ARVs. One of the supply chain managers interviewed said:

“The health system was structured for routine care and not emergencies. Our systems were never really made for pandemics of this nature, the first one of the magnitude and scale at which COVID19 affected operations and systems”. (Provincial)

Care for and supply of medicines to clients with chronic conditions such as for non-communicable diseases was temporarily relegated to non-essential services. Routine visits from central, provincial and district teams to health facilities for purposes of monitoring, support, supervision, training and data verification related to service delivery, quality of care and supply management were stalled.

4.2.2 Successes in health system, supply chain leadership, management, financing, partnership and coordination

Despite implementation challenges, most supply chain managers cited the declaration of the Ministry of Health, public and private health service providers, health development partners, related service and support organisations as essential services providers as one of the major milestones early in the pandemic. In principle their staff were eligible for travel exemption permits. This allowed some normalcy to return to the health system in the turmoil of creating COVID19 isolation and treatment centres as part of the health system response mechanism. A few weeks into the pandemic, the government also started providing dedicated transport to its essential employees including Ministry of Health and Child Care (MoHCC) and NatPharm (central medical stores) between their homes and workplaces. This eased reliance on the limited and irregular public transport service devastated by the pandemic:

“The government side, and ministry they got transportation buses, which were dedicated to ferrying, ferrying people from their homes residents to work so that helped a lot for movement of people, staff to their workplaces”. (Central)

Supply chain managers working at central level reported that the MoHCC constituted a COVID19 response taskforce with a logistics pillar that met every two weeks to provide updates to stakeholders on the state of the supply chain for COVID19 prevention, diagnosis, treatment and care commodities. The meetings also addressed the supply chain of essential programme commodities such as ARVs. The taskforce shared information on stock status of key products, helping stakeholders identify supply gaps, mobilise resources to complement government investments and follow up with suppliers of critical commodities including ARVs. Virtual communication and coordination between the HIV program, health facilities and key stakeholders such as clinical implementing partners and people living with HIV was key strategy deliberately deployed to create awareness, shared vision and avoid panic from lack of information and potential misinformation. As reported in an interview:

“We also had planning and review meetings. It's at branch level. In terms of reviewing progress, planning, and implementation of the distribution system activities, so all these meetings were able to proceed thanks to the virtual platforms which came in handy during that time”. (Central)

Regular distribution planning meetings were held at central, province and NatPharm branch store level to review progress of distribution activities across all programs. The Zimbabwe Assisted Pull System (ZAPS) meetings were also held between logistics teams and clinical partners at province and district level to manage expectations of key actors in the national supply chain. As expressed in an interview:

“The ZAPS planning meetings sort of moved into a national supply chain, a routine supply chain technical working group which would meet monthly. And it still meets monthly up to now every last Tuesday of the month where all stakeholders are in terms of the logistics team, from the provinces and the districts and the implementing partners within those districts, do come together and speak to supply chain issues, speak to the planning of the ZAPS distribution cycles”. (Central)

The MoHCC Directorate of Pharmacy Services (DPS) through an established Logistics Unit based at NatPharm continued to discharge its mandate of managing the medicines and

medical supplies distribution systems including ARVs providing necessary coverage to most hospitals and primary healthcare facilities. Provincial pharmacists also continued to play their intermediary role of coordinating the supply chain function linking the central, district and health facility level, monitoring routine and emergency distribution of ARVs and other essential medicines down to the last mile.

All managers interviewed expressed appreciation of the continued financial and technical support for ARVs procurement and supply chain operations from bilateral and multilateral donors such as the United States President's Emergency Plan for AIDS Relief (PEPFAR) and the Global Fund. During the pandemic, HIV investments were maintained and extended to include COVID19 PPE, critical equipment and consumables complementing investments from the Government of Zimbabwe (GoZ) through the National AIDS Trust Fund (NATF). Antiretrovirals remained fully funded with no gaps in supply. As said in an interview:

“The country mainly receives ARVs from multiple funding sources some of which include Global Fund, PEPFAR as well as through the National AIDS Trust Fund. All these are received into the national central medical stores, which is NatPharm central warehouse and all stock being support stock for the Ministry of Health”.

(Central)

Multi-stakeholder coordination within the supply chain by MoHCC, NatPharm, other Government of Zimbabwe institutions and health development partners was reported to have improved during the COVID19 pandemic. Quarterly Procurement and Supply Management (PSM) Committee meetings continued to be held. In the period leading up to the pandemic, savings accumulated from global price reduction for the main first line ARV and efficiencies from implementing the Global Fund grant were utilised to procure more ARVs, building inventory levels that cushioned the pipeline at the onset of the pandemic.

4.2.3 Lessons learnt in health system, supply chain leadership, management, financing, partnership and coordination

The supply chain vulnerabilities revealed by the pandemic represent underlying weaknesses in the health system particularly with regards to financing, leadership, management, human resources for health, infrastructure, adoption and use of technology. Most supply chain

managers explained why managing supply chains effectively during a pandemic requires effective leadership, coordination, partnership, and communication across sectors and among supply chain actors such as national and local government agencies, donors, procurement agencies, and suppliers. This is illustrated by the quote below:

“Going forward, I think the other lesson that we also learned with the pandemic is managing supply chains during disruptions requires effective coordination, collaboration and partnership amongst supply chain actors. Most importantly, communication”. (Central)

Bringing the client into the picture through communication was viewed as equally critical to the successes highlighted by participants in this study. Developing and implementing a communication plan, with clear and consistent messaging from the HIV programme and supply chain managers is key to managing ARV supply chains during pandemics as this quote suggests:

“I think the key thing then is that the supply chain guys, and the programme guys need to be talking the same message because without that you end up with a situation whereby people at facility level usually would probably listen to the programme guys more than the supply chain guys”. (Central)

Leveraging technology, adaptability, innovation, domestic funding, capacity building, supply chain and service integration were identified as key success factors and lessons learnt in building resilient, sustainable supply chains, ensuring pandemic readiness for continuity of essential services. While most supply chain managers expressed appreciation of the continuation of donor support for ARVs and supply chain operations, they underlined the importance of domestic funding particularly to cover the increased demand for resources, infrastructure and equipment brought by COVID19. They argued that limiting dependency on external support from partners whose priorities may shift during a pandemic was key to building resilient, sustainable supply chains. The following quote from an interview illustrates this finding:

“There was a call for the involvement of the government to say, you need not depend heavily on external support which can probably shift at any time depending on where

the crisis falls. I'm not saying that there was much change in terms of the support towards ARVs". (Provincial and Central)

Although Zimbabwe has established local financing for the HIV programme, commodities and supply chain operations in the form of the National AIDS Trust Fund, the funding is limited and needs to be complemented with additional allocations from treasury, private financing and public private partnerships.

4.3 Forecasting and supply planning

Table 2 summarises the emerging themes related to the second thematic area, forecasting and supply planning for ARVs.

Table 2: Emerging themes in forecasting and supply planning

Thematic area	Emerging Themes		
	Challenges	Successes	Lessons learnt
Forecasting and supply planning	<ul style="list-style-type: none"> • Power outages and internet connectivity challenges • Delayed dissemination of procurement plans 	<ul style="list-style-type: none"> • Intensive pipeline monitoring • Leveraging virtual platforms • Data validation and triangulation 	<ul style="list-style-type: none"> • Supplier collaboration and supply plan visibility • Managing regimen transitions

4.3.1 Challenges in forecasting and supply planning

Most managers reported that the annual quantification of March 2020 was the last face to face exercise just before the pandemic hit the country in April 2020. The mid-year quantification review was organised and conducted virtually with the HIV Program, Directorate of Pharmacy Services, NatPharm and key stakeholders meeting virtually on Microsoft Teams and Zoom platforms to gather and analyse quantification data, review program performance against ART enrolment targets, setting enrolment targets for adults and children by regimen and planning shipments to guide procurement by NatPharm, PEPFAR and Global Fund procurement agents.

All supply chain managers vividly described their maiden experience of virtual quantification and report writing. They expressed combined feelings of excitement and anxiety participating in the quantification from home against the long-established norm of face-to-face interaction with their peers and counterparts in a workshop setting. Despite virtual quantification being met with challenges, most managers felt it was generally a successful and fulfilling exercise.

The major challenges experienced were intermittent power outages from load shedding as well as internet connectivity challenges. These affected virtual participation by various quantification team members as shown by the following quote from an interview:

“Virtual meetings for an important task like quantification was one of the challenges that we faced because as a country, we have challenges with connectivity and it's persisting. We would not have everyone on board as and when we needed them. We would have, you know, like connectivity challenges. We would have electricity outages in some instances, so coordination part of it was really, quite a challenge”.

(Central)

Some participants reported losing connection and missing some of the presentations and discussions. Apart from the quantification exercise itself, most managers reported that the COVID19 pandemic delayed quantification report writing and getting the final reports out to donors and procurement agents on time to initiate procurement and to reorganize planned shipments.

4.3.2 Successes in forecasting and supply planning

Despite the challenges described above, most supply chain managers interviewed spoke passionately about how the experiences and best practices in forecasting and supply planning learnt over many years before the pandemic were useful during the pandemic. The bi-annual routine, documented processes, standard procedures and tools of forecasting and supply planning that were developed and institutionalised before the pandemic were effectively utilized during the pandemic. Having established and institutionalised processes and tools allowed for the seamless integration of technology in the form of virtual platforms.

During the pandemic, forecasting continued to be informed by morbidity and consumption data collected from health facilities reported through the Health Management Information System (HMIS) and the Logistics Management Information System (LMIS). Routine pipeline monitoring and review of supply plans in between quantification was revived intensified during the COVID19 pandemic to share information, anticipate and mitigate pipeline risks such as imminent stockouts. This was expressed in an interview:

“Then let me just speak to general pipeline monitoring and then the issues around ensuring that we routinely check the pulse of our pipeline. This is an area which we had sort of retired somewhat but we realised that the monthly and quarterly routine to review our supply plans, that is in between the quantification exercises is something we had to revive and up to today it's something we religiously do”.

(Central)

The quantification shifted into intermittent cycles of virtual and face to face exercises between COVID19 waves of high and low transmission. More recently, forecasting and supply planning was reported to have riveted to face-to-face exercise to fully benefit from real time physical interaction, strong, consistent connectivity for the web-based Quantification Analytics Tool (QAT) adopted during the pandemic.

4.3.3 Lessons learnt in forecasting and supply planning

Most supply chain managers emphasized the essential role of institutionalized, long-term forecasting and supply planning for ARVs, and other essential health commodities in ensuring a robust national supply chain. They learnt that long term forecasting and supply planning allows the HIV programme to mobilize resources, proactively share supply plans and provide visibility to manufacturers for better planning from sourcing raw materials and packaging through production to quality control testing and release of final product as expressed in the following quote from an interview:

“The lesson that I learned was there was need for procurement agencies, donors to come together, working hand in glove with manufacturers. One aspect was to proactively share supply plans so that manufacturers were able to then plan also in advance”. (Central)

Supply chain managers described how their experiences from the COVID19 pandemic demonstrated how successful management of ARV regimen and formulation transitions depends on careful planning and fidelity in execution:

“So, I think in terms of the way we manage transitions, there's also an improvement. There is a big lesson coming from the pandemic period where I think the transitions are not ambitious, you know, they are very much realistic, and their management is much smoother than the previous instances”. (Provincial and Central)

Realistic transition plans stand a better chance of success than setting ambitious targets for rapid transition that tend to result in shortage of the new regimens and formulations as well as overstocking and potential expiry of legacy formulations. This is particularly important during a pandemic that brings with it additional complexities.

4.4 Procurement

A few of the supply chain managers interviewed were directly managing procurement of ARVs for the national program. Although most of them were not directly involved in procurement, they shared their experiences as clients of the procurement function which impacted aspects of their day-to-day work as part of an integrated supply chain. Table 3 summarises the emerging themes related to the thematic area, procurement of ARVs.

Table 3: Emerging themes related to procurement

Thematic area	Emerging Themes		
	Challenges	Successes	Lessons learnt
Procurement	<ul style="list-style-type: none"> • Reliance on ARVs imports • Lockdown in India and China • Manufacturing delays • ARV API shortages • Reduced production capacity – repurposing of factories • Shortage of containers and shipping lanes • Increased shipping costs • Shipment delays and long lead time • Partial fulfilment of orders 	<ul style="list-style-type: none"> • MCAZ import waivers on time • Customs clearance streamlined • ARVs exempt from duties and taxes • Electronic documents for Customs and MCAZ • Suppliers honouring long term agreements 	<ul style="list-style-type: none"> • Technology transfer for local production • Digital procurement and import processes • Preposition stock at local and regional vendor managed warehouses • Long term agreements with suppliers • Early warning systems for risk monitoring and mitigation

4.4.1 Challenges in procurement

Most supply chain managers articulated how procurement suffered the most challenges. In the absence of local manufacturing of ARVs in Zimbabwe, the country’s ART programme relied on imports from India and China. Across the globe, there was panic at the beginning of the pandemic. Supply chain managers described how shutdowns in manufacturing countries, such as India and China, as well as in transit hubs in South Asia and the Middle East, disrupted manufacturing and shipping operations that impacted supply of ARVs into Zimbabwe:

“We also had a fair share of disruptions, supply chain disruptions as a result of COVID and one of them that we experienced was delays in our production and fulfilment of orders by the partners who are supporting us with the commodities. I

think the lead time significantly increased.... We also had the order fulfilment where some of the commodities would be shipped in bits and pieces”. (Central)

The shortage of active pharmaceutical ingredients particularly for second line ARVs was mentioned as one of the major limitations to manufacturers’ production capacity. Likewise, the combination of human resources challenges in factories because of lockdowns; shift work related to social distancing; COVID19 infections among factory workers; repurposing of factories to manufacture PPE and oxygen equipment were reported as major contributing factors to disruptions in the ARVs value chain.

Supply chain managers alluded to the global shortage of shipping containers and cargo flights that caused unprecedented challenges with shipping commodities including ARVs into the country. The shortage of containers and cargo space amid high demand increased the cost of shipping containers, sea freight and airfreight. The delays in production, late and partial fulfilment of orders by suppliers increased lead time significantly. The manufacturing and shipment delays resulted in downstream supply interruptions reported in the third and fourth quarter of 2020. The latent effect impacted the ability of the central and regional warehouse to fulfil orders from health facilities. Supply chain managers described how the situation contrasted to the pre-pandemic period when lead time for ARVs was short, on average three to four months across all three funding streams and procurement agents.

4.4.2 Successes in procurement

Despite international press reports of health products nationalisation attempts by manufacturing countries at the start of the pandemic, manufacturers and suppliers of ARVs into Zimbabwe honoured long term supply agreements and fulfilled obligations with key funders, including PEPFAR and the Global Fund. This sentiment was expressed in an interview with supply chain managers:

“During COVID times, there was talk of health products nationalism around countries who have good capacity to produce these products, but I would say for ARVs, besides the shortages of active pharmaceutical ingredients, which were shared by manufacturers or the suppliers, largely, I would say the long-term agreements between our funders and the manufacturers has really helped in this aspect because

we never faced that issue of nationalism, of resources around antiretroviral's from origin". (Central)

Despite initial challenges early in the pandemic, manufacturing was reported to have ramped up quickly following the reopening of the global supply chain space. Procurement managers reported that manufacturer and supplier warehouses were pushing available inventory into countries regardless of agreed delivery date to take advantage of the low transmission window and near normal situation between COVID19 waves.

Most supply chain managers commended the Ministry of Health Directorate of Pharmacy Services Logistics Unit for successfully monitoring the pipeline across all procuring entities, communicating supply risks, making necessary changes to supply plans, obtaining import waivers, and providing greenlight to ship. They also felt that the Ministry of Health coordinated well with relevant stakeholders to guarantee the smooth flow of ARVs from ports of entry to central and regional warehouses. This involved coordination with key institutions and partners such as the Medicines Control Authority of Zimbabwe (MCAZ), freight forwarders, clearing agents and the Zimbabwe Revenue Authority (ZIMRA) regarding in-country customs clearance of ARVs.

All upstream supply chain managers interviewed reported that importation waivers from the MCAZ were released and available on time. They mentioned that the MCAZ which at the onset of the pandemic was in the process of transitioning from manual to an electronic, web-based system for application, payment and release of waivers accelerated institutionalisation of the automated process making the waiver process more efficient:

"I wouldn't say there were many challenges in terms of securing the import permits and the related waivers. So, one other interesting thing at this point was that with respect to ARVs, MCAZ, the regulator had started transition to doing business online. They were setting up the platform to be able to communicate with the regulator online, both in terms of lodging applications for the waivers and for the regular permits in this way, disseminated through the same platform". (Central)

The existing regulatory framework was reported to be favourable with ARVs not subject to duties and taxes. In addition, they reported that ARVs, unlike COVID19 commodities such as

PPE did not require special permits such as consignment-based conformity assessment (CBCA) permits issued by the Ministry of Industry and Trade.

4.4.3 Lessons learnt in procurement

Most supply chain managers highlighted the need to bring supplies closer to where they are needed by prepositioning stock in warehouses in the country or in the region to reduce lead time and stockout risk. They also noted the importance of local production of ARVs in mitigating the impact of COVID19 and other pandemics on the supply of ARVs and other essential medicines as indicated in the following quote from an interview:

“There was also an understanding of the fact that we do not control much the things that we have to import. Yes, there is a drive. Nothing is really materialised, but there was a realisation of the need to capacitate local industry. So, with regards to ARVs, I wouldn't say we've made many strides, but there is just a vibe in the talk of manufacturing”. (Central)

4.5 Logistics Management Information Systems, data management, reporting and ordering

Table 4 summarises the emerging themes related to the fourth thematic area, Logistics Management Information Systems (LMIS), data management, reporting and ordering.

Table 4: Emerging themes related to Logistics Management Information Systems, data management, reporting and ordering

Thematic area	Emerging Themes		
	Challenges	Successes	Lessons learnt
Logistics Management Information Systems (LMIS), data management, reporting and ordering	<ul style="list-style-type: none"> • Unavailability of ZAPS ordering vehicles • Travel restrictions affecting ZAPS ordering • Order estimation 	<ul style="list-style-type: none"> • Functional systems for data management, ordering and reporting 	<ul style="list-style-type: none"> • Leveraging eLMIS data visibility and analytics • Data visibility for decision making

4.5.2 Challenges in Logistics Management Information Systems, data management, reporting and ordering

Supply chain managers interviewed described how early in the pandemic, travel lockdowns and COVID19 mitigation measures such as social distancing affected the mobility of ordering teams. Vehicles were sometimes not available to facilitate on site ZAPS data collection, verification and ordering from health facilities, hence some ordering cycles were missed in some districts. In some instances, health facilities had to send their order forms to the next level without onsite data validation:

“The drivers couldn't come especially to the hot spots, so that kind of affected how we conducted our usual ordering where the clinic said to send ZAPS order forms to the hospital, and we couldn't move around to collect and assist them with the ordering. So that was quite an adjustment for us”. (Provincial)

Supply chain managers reported that sometimes in the absence of data and facility orders, resupply quantities were estimated based on consumption from previous reporting period. This, they said, contrasts to the pre-pandemic period when district pharmacy managers visited almost all health facilities during the quarter, assisted them to place orders for ARVs and other medicines, and submitted them to NatPharm for processing. They recollected how reporting and ordering coverage under ZAPS and ZADS before the pandemic allowed order validation and approval based on up-to-date consumption, stock on hand, patient data collected and reported through the logistics management information system:

“I was responsible in terms of making sure that every quarter the health facilities submits their quarterly ordering requests which we would validate upon receipt to make sure that the patient numbers or people who were on treatment tallies with the quantities that facilities would have ordered”. (Central)

4.5.3 Successes in Logistics Management Information Systems, data management, reporting and ordering

Despite the evident challenges with ZAPS, most managers observed that the Zimbabwe ARVs Distribution System (ZADS) for hospitals, being a self-reporting and ordering system was less affected by the COVID19 pandemic. The reporting and ordering system, and the

associated logistics management information system for collecting, aggregating and reporting patient, consumption and stock on hand data for ARVs for hospitals remained functional despite reporting rates being marginally affected by the increased workload and staffing constraints that came with COVID19.

Supply chain managers stated that triangulation of logistics and patient data by the provinces and by the MoHCC DPS Logistics Unit helped to mitigate the impact of low reporting rates and inadequate quality of data thus ensuring health facilities received nearly what they needed. Similarly, throughout the pandemic period, patient and consumption data continued to be utilised to inform upstream and downstream decisions such as quantification and resupply.

4.5.4 Lessons learnt in Logistics Management Information Systems, data management, reporting and ordering

One of the key lessons learnt in Logistics Management Information Systems (LMIS), data management, reporting and ordering ARVs are the importance of data and analytics for decision making particularly during a period of uncertainty such as a pandemic. Data and analytics help to inform decisions such as shipment scheduling, replenishment of warehouses, resupplying health facilities, redistribution between warehousing and health facilities, and changes to dispensing protocol including rationing if needed to ensure equitable access to lifesaving health products such as ARVs. Another lesson learnt is the power of technology, electronic logistics management information systems and remote access to data in mitigating the impact of overlying on manual systems and human intervention.

4.6 Inventory management and control including storage and distribution

Some of the supply chain managers interviewed were involved in inventory management and control, including storage and distribution of ARVs. Table 5 summarises the emerging themes related to inventory management and control including storage and distribution ARVs.

Table 5: Emerging themes related to inventory management and control including storage and distribution.

Thematic area	Emerging Themes		
	Challenges	Successes	Lessons learnt
Inventory management and control - storage & distribution	<ul style="list-style-type: none"> • Failure of staff to report for work • COVID infection and deaths among warehouse staff • Curtailment of warehouse operations • Increased receiving time • Demurrage charges • Last mile distribution impacted • Low order fill rate • Constrained warehouse space, vehicle fleet and workforce 	<ul style="list-style-type: none"> • Inventory parameters provided adequate buffer 	<ul style="list-style-type: none"> • Large inventory holding (buffer), or prepositioning stock • Surge capacity for warehouse and transport infrastructure • Outsourcing warehousing and transport services • Building efficiencies through automation

4.6.1 Challenges in inventory management and control including storage and distribution

Most ARV supply chain managers reported that during the early days of the pandemic the movement of the health supply chain workforce was restricted. NatPharm warehouse operations were affected in the early days of pandemic as they implemented changes to the work environment. They attested that some NatPharm warehouse staff failed report for work due to limited public transport until arrangements were made to provide dedicated transport for staff.

It was reported that staff had to work under new COVID19 regulations, which was complicated for a national medical store. Working hours for NatPharm staff were reduced to allow staff to get back home after work before the lockdown night curfew. Shift work was introduced to allow social distancing in the warehouses, hospital and clinic pharmacy

storerooms and dispensaries. Despite the implementation of mitigation measures, warehouse staff were reported to have been either infected with COVID19 or affected socially causing challenges with workload due to limited staff as said in an interview:

“Unfortunately, we lost a couple of staff within you know, our warehouse. We had a driver who was infected with quite a few staff affected and what did this mean. It actually added up pressure in terms of workload onto the staff. I think this one was really quite evident because most of the staff sometimes you know they would not report for duty”. (Central)

Supply chain managers also reported an increase in offloading time for incoming shipments at NatPharm central and regional warehouse as they tried to cope with the increased range and volume of commodities managed through system that put a strain on the NatPharm workforce and infrastructure. Trucks and containers were reported to have sustained longer standing time before offloading with demurrage costs charged for containers and trucks at receiving warehouses. Likewise, receiving ARVs at health facilities took longer with skeleton staff. Supply chain managers lamented how the pandemic affected the efficiency of warehouse operations as illustrated by the following quote:

“We also had a situation where because of COVID there was like the complete lockdown in which you know the security would not even allow even essential staff to pass or go to do their national duty. So that alone actually affected in terms of the efficiencies as regards to order, process, processing, picking and packing”. (Central)

Supply chain managers expressed that at the onset of the pandemic, NatPharm was tasked to source PPE for all government departments and parastatals. NatPharm priority shifted from ARVs and other essential medicines to the much-needed COVID19 commodities such as PPE, oxygen delivery equipment and consumables. Bulky PPE items such as masks, gloves, gowns, hand sanitizers and cleaning detergents occupied significant warehouse space that the system was not prepared to handle with the available infrastructure, workforce and material handling equipment. Inbound shipments that had been delayed due to lockdowns, manufacturing and shipping constraints at the beginning of the pandemic eventually arrived at the same time putting further strain on receiving and storage infrastructure and operations.

Some PPE had to be stored temporarily in tents outside the warehouse. As one of the warehouse managers at the time put it:

“There was a sudden demand for storage space. The supply chain system was not prepared in terms of vehicle fleet capacity and human resources to handle the volume of PPE that came with the pandemic”. (Central)

Supply chain managers recounted that, although the buffer of ARVs in the country provided a cushion for most first line ARVs, the system could not maintain stock levels between minimum and maximum for some products for an extended period. Inevitably, supply levels went below minimum in the third and fourth quarter of 2020. Supply chain managers mentioned stock imbalances including expiries and shortages related to the transition of ARV regimens that were worsened by the pandemic.

Transfers of ARVs from central to regional warehouses were affected by the shift in NatPharm priorities thus affecting order fill rate for health facilities. Supply chain managers mentioned that in some cases, there were stockouts of some ARVs at regional warehouse. The COVID19 pandemic struck at a time when the country was integrating the distribution of ARVs under ZADS and ZAPS into a harmonised system adding complexity to the integration efforts.

4.6.2 Successes in inventory management and control including storage and distribution

Supply chain managers had different experiences with respect to inventory management and control of ARVs during the pandemic. Despite the numerous challenges, the main success highlighted repeatedly by most supply chain managers was how the high minimum and maximum inventory control parameters that are part of the ARVs logistics systems (ZADS and ZAPS) design allowed adequate buffer at national and health facility level for several months into the pandemic:

“Because of our min, max inventory parameters, we didn't really feel the effects of COVID induced supply chain disruptions because of our sort of thresholds for stockholding. For the first four months we had stocks, yeah, both at facility level and

also at national level. So, we were able to supply, you know, the quantities as and when they were required”. (Central)

Despite the risks associated with prepositioning and holding significant inventory of ARVs in the country both by design, as well as from reprogramming and use of savings at the end of the Global Fund new funding mechanism (NFM) grant, the coincidental build-up of stock protected the national HIV program from ARV shortages and treatment interruption.

4.6.3 Lessons learnt in inventory management and control including storage and distribution

Most supply chain managers noted that, despite the costs and risks of inventory holding, developing countries with limited resources and manufacturing capacity need to hold significant inventory to mitigate supply chain disruptions. This entails setting and maintaining relatively safe minimum-maximum inventory thresholds as part of the system design to provide safety stock or cushion from potential supply interruptions. They presented similar arguments for prepositioning inventory downstream of the supply chain including at intermediate storage facilities and at the last mile to reduce response cycle time and risk of stockout. However, they noted the need to strike a balance between the benefits and risks of inventory holding.

Supply chain managers noted the constraints placed on warehousing infrastructure and transportation highlighting the necessity to build surge capacity for warehousing and storage infrastructure, transportation and material handling equipment, either owned or outsourced. This is supported by the following quote from an interview:

“There was a drive to increase storage capacity for regional warehouses where we saw several NatPharm branches getting their new warehouse or in some instances additional warehouses being built to increase their local capacity. So, in the case of having additional buffer stocks that's then improved for the original branches. And also, in terms of the actual trucks for NatPharm, there were additional trucks also procured”. (Provincial)

Supply chain managers proposed establishment of framework contracts for outsourcing warehousing space, transport and equipment from the private sector as an option to mitigate constraints during pandemics or other emergencies while managing the total cost of ownership and redundancy.

4.7 Supply chain performance, last mile availability and dispensing

Most of the supply chain managers interviewed were involved in monitoring supply chain performance, last mile availability and dispensing of ARVs in the national program. Table 6 summarises the emerging themes related to supply chain performance, last mile availability and dispensing of ARVs.

Table 6: Emerging themes related to supply chain performance, last mile availability and dispensing

Thematic area	Emerging Themes		
	Challenges	Successes	Lessons learnt
Supply chain performance, last mile availability, access and dispensing of ARVs	<ul style="list-style-type: none"> Upstream and downstream supply chain disruptions Access to ARVs affected Low stock levels Review of dispensing protocols Temporary rationing of ARVs 	<ul style="list-style-type: none"> Misconception and stigma around risk of COVID19 infection and complications among PLHIV Multi-month dispensing Community ART refill groups 	<ul style="list-style-type: none"> Differentiated service delivery (DSD) models such as multi-month dispensing (MMD), community ART refill groups Bringing services closer to the client

4.7.1 Challenges in supply chain performance, last mile availability and dispensing

Most supply chain managers interviewed felt that the Zimbabwe ARVs supply chain experienced a fair share of disruptions because of COVID19. They described how COVID19 caused disruptions to the supply chain upstream and downstream. The beginning of the pandemic was characterised by lockdowns, in-adequate staff working in health facilities, with

some facilities closed and inaccessible to patients to get their ARVs supplies as reported by a supply chain manager in an interview:

“We also had instances where even facilities, clinics were closed, facilities were not able to open because of the pandemic and at the same time also the patients were supposed to go to the clinic. Sometimes they were not even allowed to go because of the lockdowns. So, it was really quite a situation that we encountered, which was very, very difficult”. (Central)

Similar sentiments were expressed in another interview:

“In general, the lockdown caused a lot of effects on transportation, yes, on distribution on even access it was limited access for our clients during the pandemic, so yes, that changed, and we had to adjust accordingly”. (Provincial)

The managers reported that, in some communities, for the first few weeks of the pandemic, patients had to secure permits or present patient cards at established checkpoints to travel to the clinics and hospitals.

The HIV Programme and Directorate of Pharmacy Services had to provisionally review the dispensing protocol for ARVs in view of COVID19 prevention measures and to take into account the available stock of ARVs. Health facilities were allowed to use their discretion to decide on quantities to dispense based on available stock at the health facility without necessarily anticipating resupply to avoid all ARVs being taken up by first comers. As was said during an interview, clients on first line ARVs receiving six- and three-months dispensing had to receive less than their usual supply:

“So with the collaboration of the programme we wrote to facilities to restrict dispensing to anything below 3 MMD [three months of supply] the standard which we had been offering for quite some time and the guidance was that facilities were supposed to make decision in terms of how much to give per client based on the stock which they had at the facility, not the anticipation of whatever was coming through order fulfilment from the warehouse”. (Central)

Clients on second line ARVs remained on three or less months' supply because of potential risk of poor viral suppression as well as inadequate supply availability. Supply chain managers reported isolated cases of belief and associated stigma about higher risk of COVID19 infection and complications among people living with HIV (PLHIV) that prevailed in some communities early in the pandemic.

4.7.2 Successes in supply chain performance, last mile availability and dispensing

Despite the extraordinary supply chain challenges, ARVs were generally available and accessible to clients during the COVID19 pandemic. As discussed earlier, the effects of the pandemic were not felt initially on the supply chain because of the minimum-maximum inventory parameters for the ARVs supply chain. When supplies were deemed adequate, multi-month dispensing of ARVs to stable, virally suppressed patients helped to decongest health facilities and mitigate the negative impact of travel restrictions and health facility access challenges especially for patients on first line treatment. The concept of community ART refill groups where one patient collected ARVs for others in their community was also intensified in some areas during the pandemic.

4.7.3 Lessons learnt in supply chain performance, last mile availability and dispensing

Several supply chain managers described how critical it was to ensure continuity of essential services such as ART during the COVID19 pandemic period when the focus of the health system shifted to managing the public health emergency at hand. They argued that this realisation necessitates a paradigm shift in approaches to essential health services delivery by integrating services and products traditionally provided through vertical programmes such as HIV, TB, family planning, non-communicable diseases, maternal, newborn and child health to a one stop model for improved access during public health emergencies.

Differentiated service delivery (DSD) models such as multi-month dispensing helped minimize movement of patients into health facilities and mitigate supply interruptions. Supply chain managers advocated for strengthening and scaling of patient centred approaches such as multi-month dispensing (MMD) for stable, virally suppressed patients which helped improve access to ARVs during pandemics. These lessons learnt is illustrated by the following quote from an interview:

“I think it taught us that we can move to the multi month dispensing. Yeah, we can provide multiple months dispensing to our clients, those who are stable and not have to give them three months when the supplies do afford that”. (Provincial)

The community ART refill group (CARG) model, whereby clients collect medicines on behalf of peers, also reduced movement of patients into health facilities, preventing infections among staff and clients while mitigating supply interruptions.

Overall, the study revealed considerable challenges and risks in Zimbabwe’s ARVs supply chain during the COVID19 pandemic, as experienced by supply chain managers working at central and provincial level. It documented upstream and downstream disruptions and vulnerabilities ranging from lockdown, travel restrictions, API shortages, reduced manufacturing capabilities, shipping delays, warehousing constraints, data visibility, ordering and distribution challenges that ultimately affected last mile availability, dispensing and clients’ access to ARVs. Despite the challenges, the study revealed some innovations and successes across various supply chain functions, built on several years of investment and implementation. Furthermore, there are some key lessons learnt from managing supply chains during the COVID19 pandemic that can inform best practice recommendations and guidance for future investments and changes to make supply chains more resilient during crisis.

Chapter 5: Discussion

5.1 Introduction

This study explored the experiences of supply chain managers managing the ARVs supply chain during the COVID19 pandemic in Zimbabwe. It describes, from the perspective of those who experienced, how a seemingly robust supply chain management system supporting delivery of essential health services was put to test by an epidemic that shocked the world. This research contributes to the body of knowledge on managing supply chains during the COVID19 pandemic drawing on the successes, challenges, innovations and lessons learnt from the ARVs supply chain in Zimbabwe, that could inform best practices for resilient, sustainable supply chain management during future pandemics and related emergencies.

The study noted a general consistency of perspectives among supply chain managers interviewed, as well as some peripheral differences that depend on the respondents' role and tier within the supply chain, geographical location and sphere of activity. The following sections discuss the key successes and challenges experienced by the study participants and conclude with the key lessons learnt.

5.2 Key successes

The study showed that supply chain managers observed some successes in the supply chain management of ARVs during the pandemic across most thematic areas. There was marked improvement in coordination and communication among key stakeholders around planning, execution and monitoring of ARV supply chain operations during the COVID19 pandemic. The COVID19 pandemic also reinforced the intensity of routine pipeline monitoring, data triangulation and validation. Digitalisation and timely processing of import waivers from the Medicines Control Authority of Zimbabwe (MCAZ), streamlined customs clearance, and leveraging long-term agreements with suppliers were cited as key successes in supply chain management of ARVs during the pandemic. Although some of the successes came with the pandemic, some existed before but were accelerated and amplified during the pandemic.

Systems for data management, reporting and ordering ARVs remained mostly functional and capable of informing resupply, redistribution and quantification decisions. The relatively high minimum and maximum inventory parameters built into the ARVs logistics system design provided adequate buffer that minimised supply disruption at national and health facility

level in the early months of the pandemic in Zimbabwe. Overall, the study shows that the pandemic effects on the supply and availability of ARVs in Zimbabwe were minimal. Similarly, an assessment conducted by Dorward *et al* (2021) on the impact of COVID19 on HIV care services in South African primary care clinics did not find evidence of significant disruptions to ART services. In Ethiopia, inventory analysis of 24 ARVs at national and subnational level in December 2020 showed that 82 percent of ARVs were not at risk of stockout with more than six months of supply (GHSC-PSM, 2020).

5.3 Key challenges

The study documented lockdowns and psycho-social strain among the challenges faced by ARV supply chain managers and their clients during the COVID19 pandemic. The psychosocial impact that COVID19 had on the health supply chain workforce and their clients is a phenomenon also found by Tirivangani *et al* (2021) in their study of the impact of COVID19 on the pharmaceutical sector in Namibia. This finding was to be expected given that such an unprecedented global situation of rapidly spreading infections and deaths had not been experienced for many years.

Supply chain managers perceived forecasting and supply planning challenges mainly emanated from the social distancing requirements that prevented face to face quantification. Although virtual quantification was mostly successful, electricity outages and internet connectivity challenges affected participation of key stakeholders. The shift delayed the dissemination of procurement plans and reports to donors and procurement agents thus affecting the effective and efficient execution of procurement. The study findings are similar to observations made by the Global Fund Office of the Inspector General (OIG) who noted inherent limitations that affected its Pooled Procurement Mechanism (PPM's) ability to achieve procurement efficiencies and effectiveness (Global Fund OIG, 2021). They found that annual forecasts for ARVs were lower than actual procurements creating procurement inefficiencies and challenges with scheduling production.

From this study, ARVs supply chain managers in Zimbabwe noted the reliance on ARVs imports, API shortages, manufacturing and shipment delays and increased freight costs as causes of partial fulfilment of orders and long lead times. The Global Fund OIG report (2021) on procurement and supply management during COVID19 pandemic similarly observed long

lead times that increased the risk of stockouts. Another rapid assessment by the Global Fund showed moderate but increasing COVID19 impact on health products supply, a result of reduced production in India and freight constraints (The Global Fund, 2021).

This study revealed how the failure of NatPharm and health facility staff to report for work due to lockdowns, lack of public transport, fear of COVID19 infection and death among staff and social distancing measures affected warehousing and distribution operations. The United Nations Children's Fund (UNICEF) documented similar challenges of access to health services due to travel restrictions, lack of public transport, staggered working hours and curtailed operations at the onset of the pandemic in Zimbabwe (United Nations Children's Fund, 2020). This affected inter-warehouse stock transfers, receiving, storage, picking, packing and dispatch of orders. The disruptions also increased offloading and receiving time at warehouses and health facilities causing demurrage costs charged by transporters of inbound shipments. Low order fill rates as well as delayed and poor coverage of last mile distribution as well as low inventory levels affected the availability of ARVs at service delivery and dispensing points.

The unavailability of ordering vehicles and travel restrictions was cited by ARV supply chain managers in Zimbabwe during the COVID19 pandemic as the key challenge to data management, reporting and ordering of ARVs. In the absence of complete or up to date information, data extrapolation and order estimation was used to inform resupply decisions. It appears that data extrapolation and order estimation may have caused some of the supply imbalances, including overstocking and shortages observed during the early pandemic period. Our findings are consistent with those from a survey by World Health Organization (2020) in which twenty-four countries reported critically low stocks of ARVs.

The observed disruptions in the local ARV supply chain led to some shortages in the third and fourth quarters of 2020. The study results are also like those from an assessment of the Global Fund supply chain investments in Zimbabwe which showed a decline in performance against two key performance indicators, order fill rate and stockouts during the pandemic period (Lesego *et al*, 2024). The study attributed the declining order fill rate and increased stockout rates to COVID19 related supply chain disruptions that complicated the transition from adult Tenofovir/Lamivudine/Efavirenz (TLE) to Tenofovir/Lamivudine/Dolutegravir (TLD) based regimens.

5.4 Key lessons learnt

There are many key lessons to be learnt from the supply chain challenges and vulnerabilities brought by the COVID19 pandemic. The lessons learnt are critical to informing best practices, innovations and changes to the design and operation of supply chains to make them more resilient to external shock. This study shows that one of the key lessons learnt is the importance of communication, coordination and partnership among key stakeholders to ensure alignment around common objectives, consistent messaging on priorities, resource needs, commitments and scenario planning. The Global Fund made similar recommendations for on time and open communication to prevent alarm and to develop backup plans (The Global Fund, 2021). Another key lesson learnt is the importance of protecting the health supply chain workforce to ensure that they are available to operate and monitor the supply chain. Despite the important role of the supply chain workforce, our results show that over-relying on human intervention is a vulnerability as staff are equally at risk as their clients during pandemics and other public health emergencies. Leveraging technology to digitalise and automate some parts of the supply chain is imperative.

Developing long-term forecasts and supply plans and proactively sharing supply plans with manufacturers enables better production planning and fulfilment of orders. Researchers have proposed similar solutions such as long-term forecasting, resource mobilization, from global funding agencies as well as exploring alternative sources of supply and methods of shipping have been proposed by (Elsayed and Hassany, 2020). The key lessons learnt in procurement of ARVs are the importance of local or regional manufacturing, automating import and export processes, prepositioning stock at local and regional vendor warehouses, and establishing long term agreements with key suppliers. The initiatives will reduce lead time, improve on time in-full delivery of orders. The local production of APIs and formulated ARVs could mitigate impact of product nationalization in importing countries. Data from this study highlighted the threat of product nationalisation by some countries manufacturing ventilators, PPE, lopinavir APIs and COVID19 vaccines during the pandemic. Similarly, the 5th North America International Conference on Industrial Engineering and Operations Management noted that many countries, including the United States, rely on China and India as the major sources of pharmaceutical APIs and how they were impacted by the COVID19 outbreak and ensuing lockdown in China in February and March 2020 (Strong *et al*, 2020).

Building a robust supply chain with diverse sources of APIs and excipients are necessary to fortify pharmaceutical supply chains against disruptions. A study by Tirivangani *et al* (2021) exploring the impact of COVID19 on the pharmaceutical sector in Namibia underscored the importance of public-private partnership and investment in local manufacturing in building strong supply chains for pharmaceuticals and PPE to alleviate the impact of public health emergencies. Investments in pooled procurement mechanisms and regional manufacturing, if leveraged through regional economic communities such as the Southern African Development Community have the potential to protect local supply chains from disruptions in the global supply chain space (SADC GIZ-SIPS, 2022). These opportunities for investment require political commitment and an enabling environment provided by the governments of member states. Despite this realization, not much progress in ARVs local manufacturing has been made in Zimbabwe and the region outside of South Africa.

The results of this study highlight the importance of leveraging eLMIS data visibility and analytics to inform critical decisions to maintain uninterrupted supply of lifesaving commodities within the public health supply chains under pandemic conditions. Similar assertions have been made that electronic inventory management systems providing up to date information from the lowest level dispensing unit have the potential to inform long-term orders to support multi-month dispensing and buffer stocks need to be in place during pandemics (Rewari *et al*, 2020). Digitalising the supply chain through electronic logistics management information systems (eLMIS) and e-commerce facilitates remote data visibility, transacting, monitoring, supervision, control and has the potential to deliver efficiencies during a pandemic. Beyond the pandemic, measures need to be established to institutionalize and sustain the innovations and improvements started during the pandemic.

Prepositioning of stock in-country, investing in surge capacity for warehouse and transport, establishing framework contracts for outsourcing services to the private sector and automation were key lessons learnt for building efficiencies and reducing supply chain vulnerabilities. Digitalisation and localisation of supply chains have been suggested as measures that can be explored to mitigate impact of COVID19 and other pandemics on supply chains (Aljuneidi *et al*, 2023). These strategies represent a new paradigm in building supply chain resilience for the future that leverages both public and private sector investments in infrastructure, equipment and service delivery. The Government of Zimbabwe, with support from the Global Fund embarked on capital projects to expand the

storage capacity at NatPharm's central and regional warehouses as well as at district hospitals and health facilities (Lesago *et al*, 2024). Similar investments by the Global Fund in a new fleet of trucks for NatPharm has added to the transport capacity and efficiency of transport operations. The Global Fund investments in critical information communication technology (ICT) hardware, connectivity and eLMIS software and solar for health will build efficiencies into the supply chain, reducing overreliance on manual, human intervention for execution of essential tasks. (Lesago *et al*, 2024).

Another key lesson learnt is the importance of innovation and ability to pivot to changing situations in the supply chain. An exploratory study of the public sector PPE supply chain in Scotland's National Health Service illustrated the application of resilience strategies such as adaptability, nimbleness and surge capacity in healthcare supply chain settings (Scala and Lindsay, 2021). The challenges in last mile availability of ARVs prompted relief measures such as temporary measures to allow circumstantial and flexible application of ARVs dispensing protocols. Depending on their stock status and circumstances, health facilities were able to increase or reduce the months of supply dispensed to clients within the range of one to six months as opposed to the standard of care that promoted multi-month dispensing to improve equity of access and continuity of treatment. These findings resonate with World Health Organisation and United Nations Programme on HIV/AIDS recommendations for improving continuity of care through process innovation and differentiated services (World Health Organisation, 2020b; United Nations Programme on HIV/AIDS, 2020).

Differentiated, client centric service delivery models such as multi-month dispensing, community ART refill groups, community outreach models, and use of the private sector have a role to play in ensuring continuous flow of essential health services and products during pandemics and other public health emergencies. Adoption of multi-month dispensing of ARVs is one among the coping strategies adopted in South Africa at the beginning of the COVID19 pandemic (Mendelsohn and Ritchwood, 2020). Similarly, the World Health Organisation interim guidance recommended dispensing for up to 6 months to limit the risk of interruptions to the supply of ART (World Health Organisation, 2020a). These recommendations need to be adopted after careful consideration of the implications of six months dispensing on available inventory where shorter periods of dispensing may be

advisable. Similarly, in Nigeria, patients received long term supplies of ARVs to ensure continuity of treatment during lockdowns (The Global Fund, 2020).

Exploring private sector approaches to service delivery on a cost reimbursement model as opposed to narrowly focusing on traditional public sector archetypes bring services and products closer to the clients and mitigate access challenges during a pandemic. Strong *et al*, (2020) proposed private models for distribution of medicines during pandemics including home delivery to avoid in-person contact and preventing infections. These outreach models to reach clients within their communities need to be explored, tested and scaled if proven successful.

5.5 Study limitations

Notwithstanding the apparent suitability of in-depth interviews for the study as well as the strategies implemented to ensure rigor, there were some limitations to this study. The sample size, resources and time dedicated to the study were limited by the scope of the mini-thesis research. The results from this study can only be applied in the context of the study setting or very similar settings and cannot be generalised. It is assumed that the information that was provided by study participants is accurate, reliable, and mostly complete given that participants were subject matter experts in their areas of practice and that data saturation seemed to have been achieved at the conclusion of all in-depth interviews.

Further studies are required to explore this subject in other settings as well as to document quantitative aspects of COVID19 impact on supply chains. However, this study contributes to the body of knowledge in managing public health supply chains including key lessons learnt to inform best practice strategies to improving supply chain performance, health products availability and service delivery.

Reflexivity was exercised throughout the study process to ensure self-awareness and reflect on the researcher's role in the research process, acknowledging researcher biases related to their employment, personal relationships, professional connections, working or institutional history and vested interest in the study setting. During the period covered by this study, the researcher had an independent technical advisory role to the Ministry of Health and Child Care and NatPharm, providing technical assistance in end-to-end supply chain management of medicines and medical supplies. Technical assistance provided covered coordination,

quantification, procurement, storage, distribution, management information systems monitoring and evaluation. At the time that the research was conducted, the researcher did not have a role in the Zimbabwe ARVs supply chain having left the role in November 2020. The researcher's current and past role does not present real conflict of interest or views given their independent role and funding.

Chapter 6: Conclusion and recommendations

6.1 Conclusion

This study demonstrated limited preparedness of the Zimbabwe ARVs supply chain system to cope with a pandemic of this nature and magnitude. Challenges experienced by supply chain managers ranged from lockdown, travel restrictions, API shortages, manufacturing delays, shipment delays, warehousing constraints, ordering and distribution difficulties. Despite the challenges, there were successes and innovations that were necessitated by the pandemic as part of coping strategies. The study findings showed improvements in coordination and communication among stakeholders, intensified pipeline monitoring, risk awareness, logistics process streamlining, systems for data extrapolation, validation and triangulation as well as utilisation of buffer stock accumulated before the pandemic. Despite the obstacles in the supply chain, the study shows that, in general, the pandemic effects on the availability and access ARVs in Zimbabwe were negligible.

Most importantly, there were some lessons learnt. The disruptions and vulnerabilities uncovered by this study point to the need to strengthen health supply chain systems to make them more resilient to pandemic shocks. Resilience strategies should be part of an intentional plan rather than an afterthought. Adaptability, innovation and change management enables the supply chain to respond better to changing situation during pandemics. Efficiencies in the supply chains, leveraging technology, domestic financing, local and regional procurement, prepositioning stock, surge capacity in warehousing and transport capabilities, outsourcing services, public-private partnership, and new models for client centred service delivery are novel approaches that provide opportunities for protecting healthcare supply chains from undesirable effects of pandemics and related emergencies.

6.2 Recommendations

The following recommendations drawn from the study findings are relevant to public health supply chain policy makers, funders and operators during future pandemics and related emergencies:

- develop and share long-term forecasts and supply plans with funders, procurement agencies, manufacturers and suppliers to enable better production planning and fulfilment of orders;
- promote local or regional manufacturing, prepositioning stock at local and regional warehouses and establishment long term agreements with key suppliers;
- invest in surge capacity for warehousing and transport including establishing framework contracts for outsourcing services to the private sector;
- invest in technology to improve efficiency in the supply chain through automation, remote, electronic data visibility and analytics for decision making;
- explore differentiated, client centric service delivery models such as multi-month dispensing, community dispensing, outreach models, and use of the private sector to ensure last mile availability and access to essential health services and products.

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Appendices



University of the Western Cape

Appendix A: Interview guide

Introduction

After formal introductions, explanation about the purpose of the study and obtaining dully signed consent; the in-depth interviews will proceed guided by the following questions:

1. What was your role in managing the supply chain for ARVs in Zimbabwe during the COVID19 pandemic?
2. Can you describe the situation regarding the supply of ARVs in Zimbabwe before the COVID19 pandemic?

Prompt questions to elicit more information related to the following supply chain functions:

- a. Forecasting and supply planning
 - b. Procurement including international import, freight & logistics, customs clearance.
 - c. Warehousing and storage
 - d. Ordering
 - e. Order fulfilment (resupply) and distribution
 - f. Dispensing
3. How did the situation change at the beginning and during of the pandemic?
 - a. Can you describe the negative changes or challenges that came with the pandemic?
 - b. Can you describe the positive changes that came with the pandemic?
 - c. Prompt questions to elicit more information related to the following supply chain functions:
 - i. Forecasting and supply planning

- ii. Procurement including international import, freight & logistics, customs clearance.
 - iii. Warehousing and storage
 - iv. Quality assurance
 - v. Ordering
 - vi. Order fulfilment (resupply) and distribution
 - vii. Dispensing
4. What lessons did you learn in managing supply chains during the pandemic?
- Prompts:
- a. Long term forecasting and supply planning
 - b. Local production and sourcing
 - c. Import processes and procedures.
 - d. Buffer stock
 - e. Pre-positioning stock
 - f. Surge capacity in warehousing, transportation, staffing and regulatory capacity.
 - g. Use of technology and data visibility
 - h. Communication and coordination
 - i. Other resilience strategies
5. What changes have been made to the supply chain for ARVs in Zimbabwe to adapt to the COVID19 pandemic?
- a. If there were changes, why do you think these changes were necessary?
 - b. If there have not been changes, why do you think there haven't been any changes?
6. What have been the short-term impact of changes on the supply of ARVs in Zimbabwe?
- a. Negative impact
 - b. Positive impact
7. What have been the long-term impact of changes on the supply of ARVs in Zimbabwe?
- a. Negative impact
 - b. Positive impact
8. In your opinion, what additional changes are necessary to cope with future pandemics?
- Prompt: Are any of these changes being put in place?



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UNIVERSITY of the WESTERN CAPE

Appendix B: BMREC Approval

02 February 2024

Mr T Chitsike and Dr H Bradley
School of Public Health
Faculty of Community and Health Sciences

BMREC Reference Number: BM23/10/31

Project Title: Exploring the experiences of supply chain managers involved in antiretroviral medicines in Zimbabwe during the COVID19 pandemic.

Approval Period: 02 February 2024 – 01 February 2025

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above-mentioned research project.

Any further amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit an annual progress report at least two months before expiry date. Failure to submit your annual progress report on time will result in the immediate lapse of your ethics approval and you will have to resubmit an entirely new ethics application.

For permission to conduct research using student and/or staff data or to distribute research surveys/questionnaires please apply via: <https://sites.google.com/uwc.ac.za/permissionresearch/home>

The permission letter must then be submitted to BMREC for record keeping purposes.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms. Patricia Josias
Coordinator: Research Ethics
University of the Western Cape

Appendix C: Medical Research Council of Zimbabwe Ethical Approval

Telephone: +2638644073772
E-mail: mrcz@mrcz.org.zw
Website: <http://www.mrcz.org.zw>



Medical Research Council of Zimbabwe
20 Cambridge Road
Avondale
Harare
Zimbabwe

APPROVAL

Ref: MRCZ/B/2630

25 March 2024

Tinei Chitsike
University of Western Cape
School of Public Health
Robert Sobukwe Road
Bellville 7535
South Africa

RE: - Exploring the Experiences of Supply Chain Managers Involved in Antiretroviral Medicines in Zimbabwe during the COVID-19 Pandemic

Thank you for the application for the review of research activity that you submitted to the Medical Research Council of Zimbabwe (MRCZ). Please be advised that the Medical Research Council of Zimbabwe has **reviewed** and **approved** your application for the above-titled study.

This approval is based on the review and approval of the following documents that were submitted to MRCZ for review: -

1. Completed MRCZ form 101 for new study applications
2. Full protocol
3. Informed Consent Forms
4. Data Collection Tool

APPROVAL NUMBER : MRCZ/B/2630

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

- **TYPE OF MEETING : EXPEDITED**
- **APPROVAL DATE : 25 March 2024**
- **EXPIRATION DATE : 24 March 2025**

After this date, this project may only continue upon renewal. For renewal purposes, a progress report on a standard form obtainable from the MRCZ offices should be submitted three months before the expiration date for continuing review.

1. **SERIOUS ADVERSE EVENT REPORTING:** All serious problems having to do with subject safety must be reported to the Institutional Ethical Review Committee (IERC) as well as the MRCZ within 3 working days using standard forms obtainable from the MRCZ Offices or website.
2. **MODIFICATIONS:** Prior MRCZ and IERC approval using standard forms obtainable from the MRCZ Offices is required before implementing any changes in the Protocol (including changes in the consent documents).
3. **TERMINATION OF STUDY:** On termination of a study, a report has to be submitted to the MRCZ using standard forms obtainable from the MRCZ Offices or website.
4. **QUESTIONS:** Please get in touch with the MRCZ by Telephone at No. 08644073772 or by e-mail at mrcz@mrcz.org.zw

Other

1. Please be reminded to send in copies of your research results for our records as well as for the Health Research Database.
2. You're also encouraged to submit electronic copies of your publications in peer-reviewed journals that may emanate from this study.
3. **In addition to this approval, all clinical trials involving drugs, devices, and biologics (including other studies focusing on registered drugs) require approval of the Medicines Control Authority of Zimbabwe (MCAZ) before commencement**

Yours Faithfully


MRCZ SECRETARIAT
FOR CHAIRPERSON
MEDICAL RESEARCH COUNCIL OF ZIMBABWE



PROMOTING THE ETHICAL CONDUCT OF HEALTH RESEARCH



UNIVERSITY of the
WESTERN CAPE



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Appendix D: Information sheet

Date:

Topic: Exploring the experiences of antiretroviral (ARV) medicines supply chain managers in Zimbabwe during the COVID19 pandemic

Dear [Participant Name]

I, Tinei Chitsike, am pursuing my Master of Public Health degree in the School of Public Health at the University of the Western Cape, South Africa. I would like to invite you to take part in my research project. Please take time to read the following information carefully, and please feel free to ask questions if anything you read is not clear to you or if you'd like more information.

What is the study about?

The purpose of this research is to describe and explain the successes, challenges and lessons learnt in managing supply chains for ARVs in Zimbabwe during the COVID19 pandemic. The study will inform best practices for ensuring resilient and sustainable management of supply chains ART and related programs in Zimbabwe and in similar settings during future COVID19 or related pandemics.

Why are you being invited to participate in this study?

You are being invited to participate in this study because of your role and experience managing the supply chain for ARVs in Zimbabwe.

What will you be expected to do in this study?

If you voluntarily agree, you will be expected to participate to in-depth interview to collect data on your experiences managing the ARVs supply chains in Zimbabwe during the

COVID19 pandemic. A semi-structured interview guide with a combination of structured and open-ended questions will be used to conduct in-depth interviews.

What are the potential risks involved in this study?

There are potential ethical risks associated with this study. The ethical risks and measures that will be taken to mitigate the risks are described below.

There is a risk that research participants may participate without adequate information and understanding of the purpose, expectations, risks, and benefits of the study. To mitigate this risk, adequate information will be provided to research study participants to make sure they understand the purpose, expectations, risks, and benefits of participating in the study. This information will be provided through a written participant information sheet in the language understood by the participants. This information will also be explained fully to each participant before the interview.

The other risk is that participants may feel obligated to participate in the research study. To mitigate this risk, all participants will be requested to provide voluntary consent to participate in this research study, understanding that they are under no obligation to participate. This will be achieved through a written informed consent form that will be explained to and voluntarily signed by participants prior to participating in the in-depth interviews. The informed consent form will be written and explained in English language that the participants understand.

Participants may also feel obligated to continue participating in the research study even when they feel uncomfortable. To mitigate this risk participants will be made aware that they reserve the right to withdraw from this research at any time without the need to explain the reason for withdrawal and that their withdrawal from the research study will not have any negative consequences or penalties such as withdrawal of benefits and rights. Participants will also be informed that they have the right to refuse to answer any question that they are not comfortable answering.



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There is also a risk that confidentiality of information provided by participants may not be maintained and that information provided may be disclosed to third parties. To mitigate this risk, all personal and other information provided by research participants including written and video records will be kept under lock and key or password protected during and after the research study. Records will be kept for five years after which they will be destroyed. Participants will be guaranteed anonymity so that the information provided is not personally identifiable.

There is a risk that researchers may have a conflict of interest in conducting the research study that may compromise the integrity of the research process and study results. To mitigate this risk, the researchers have declared no conflict of interest and undertake to declare and mitigate any real or perceived conflict of interest that may arise during the study. The researchers also undertake to communicate the results of the research to study participants and the broader public health community for transparency and for the benefit of the community.

What are the potential benefits involved in this study?

There are no direct benefits you will get from this study. Likewise, there are no costs to you for participation apart from the time you will commit to the in-depth interviews and/or discussions. However, the information and knowledge the study will benefit the public health and community in Zimbabwe.

What COVID 19 Protocols are in place? (If applicable)

In-depth interviews will be conducted virtually using Zoom, Microsoft Teams and Google-Meet. There are no applicable COVID19 risks or protocols involved.

Will my details be kept confidential?

Your confidentiality in this research is guaranteed. All recording of in-depth interviews and transcripts will be kept under lock and key during the entire duration of the research. On completion of the research all original data, records will be archived securely under lock and



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key for five years after which they will be destroyed. All audio and video recordings will be password protected.

What type of personal information will be collected?

Your email address, phone number, organization, employment information and role in managing the ARVs supply chain will be collected during the interview process.

Who at UWC is responsible for collecting and storing my personal information?

Only the researcher, the UWC supervisor and UWC head of department will be responsible for collecting and storing all interview including personally identifiable information.

Who will have access to my personal information outside of UWC?

No one outside of the UWC will have access to the interview information.

How long will my personal information be stored?

Personal electronic data will be kept on the researcher's/supervisor's password protected computer for five years and deleted thereafter. Hard copies will be kept in a locked drawer for five years and deleted thereafter. **How will my personal information be processed?** Your personal information will remain as part of the raw, recorded, and transcribed password (electronic) or locked (hard copy) data. It will not be included in the analysis, results nor publication.

Who do I contact for further information?



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Should you require any further information, please do not hesitate to contact me Tinei Chitsike on my cell phone (+258 84 320 2866) or via email (4104268@myuwc.ac.za). Alternatively, you may also contact my supervisor Dr Hazel Bradley in the School of Public Health, University of the Western Cape (UWC), hbradley@uwc.ac.za.

To report any ethical issues, adverse or unexpected effects emergent from this research, please contact:

Medical Research Council of Zimbabwe (MRCZ)
20 Cambridge Road, Avondale, Harare.
+263 86 44073772.

Biomedical Research Ethics Committee
Research and Postgraduate Division
University of the Western Cape
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This information sheet is for you to keep so that you can be aware of the purpose of the study. With your signature on the attached consent form, you indicate that you understand the purpose of the exercise.

Appendix E: Informed Consent Form

MRCZ No. MRCZ/B/2630 Version 14/03/2024

MRCZ INFORMED CONSENT FORM 109

PROJECT TITLE

Exploring the experiences of supply chain managers involved in antiretroviral medicines in Zimbabwe during the COVID19 pandemic.

Principal Investigator Tinei Chitsike, [*B. Pharm, University of Zimbabwe*]

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What you should know about this research study:

- We give you this consent so that you may read about the purpose, risks, and benefits of this research study.
- You have the right to refuse to take part or agree to take part now and change your mind later.
- Please review this consent form carefully. Ask any questions before you decide.
- Your participation is voluntary.

PURPOSE

You are being asked to participate in a research study of the experiences of antiretroviral (ARV) medicines supply chain managers in Zimbabwe during the COVID19 pandemic. The purpose of the study is to describe and explain the successes, challenges and lessons learnt in managing supply chains for ARVs in Zimbabwe during the COVID19 pandemic. The study will inform best practices for ensuring resilient and sustainable management of supply chains ART and related programs in Zimbabwe and in similar settings during future COVID19 or related pandemics. You were selected as one of ten participants this qualitative research study because of your role and experience managing the supply chain for ARVs in Zimbabwe.

PROCEDURES AND DURATION

If you decide to participate, you will undergo an in-depth, one on one interview to collect data on your experiences managing the ARVs supply chains in Zimbabwe during the COVID19 pandemic. A semi-structured interview guide with a combination of structured and open-ended questions will be used to conduct in-depth interviews.

This study involves audio and/or video recording of virtual in-depth interviews conducted by the researcher using Microsoft Teams, Zoom and Google Meet platforms. Recordings will be transcribed into word text, followed by manual, thematic coding which will form the basis for analysis and interpretation. All personal information and recordings will be collected, stored confidentially by password protection, processed in accordance with the requirements of laws relating to the Protection of Personal Information. Recordings will be disposed by complete deletion after transcription within one month of completing the interviews.

RISKS AND DISCOMFORTS

There are potential ethical risks associated with this study. The ethical risks and measures that will be taken to mitigate the risks are described below.

There is a risk that as a research participant, you may participate without adequate information and understanding of the purpose, expectations, risks, and benefits of the study. To mitigate this risk, adequate information will be provided to you to make sure you understand the purpose, expectations, risks, and benefits of participating in the study. This information will be provided through a written participant information sheet in the language understood by you. This information will also be explained fully to you before the interview.

The other risk is that as a participant, you may feel obligated to participate in the research study. To mitigate this risk, you will be requested to provide voluntary consent to participate in this research study, understanding that you are under no obligation to participate. This will be achieved through this written informed consent form that will be explained to and voluntarily signed by you prior to participating in the in-depth interviews. The informed consent form will be written and explained in English, being a language that you understand.

As a participant, you may feel obligated to continue participating in the research study even when you feel uncomfortable. You reserve the right to withdraw from this research at any time without the need to explain the reason for withdrawal and that your withdrawal from the research study will not have any negative consequences or penalties such as withdrawal of any benefits and rights. You have the right to refuse to answer any question that they are not comfortable answering.

There is also a risk that confidentiality of information provided by you may not be maintained and that information provided may be disclosed to third parties. To mitigate this risk, all personal and other information provided by you including written and video records will be kept under lock and key and/or password protected during and after the research study. Records will be kept for five years after completion of study.

BENEFITS AND/OR COMPENSATION

There are no direct benefits you will get from this study. Likewise, there are no costs to you for participation apart from the time you will commit to the in-depth interviews and/or discussions. However, the information and knowledge the study will benefit the public health and community in Zimbabwe.

CONFIDENTIALITY

Your confidentiality in this research is guaranteed. All recording of in-depth interviews and transcripts will be kept under lock and key during the entire duration of the research. On completion of the research all original data, records will be archived securely under lock and key for five years after which they will be destroyed. All audio and video recordings will be password protected. Only your email address, phone number, organization, employment information and role in managing the ARVs supply chain will be collected during the interview process. Only the researcher, the UWC supervisor and UWC head of department will be responsible for collecting and storing all interview including personally identifiable information. No one outside of the UWC will have access to the interview information. MRCZ may request access to information for audit purposes.

COSTS

There are costs associated with internet access during the interview process. No additional costs are anticipated.

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. If you decide not to participate in this study, your decision will not affect your future relations with the University of the Western Cape, its personnel, and associated institutions. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without penalty.



Appendix F: Data Management Plan

Title of Research Project: Exploring the experiences of antiretroviral medicines supply chain managers in Zimbabwe during the COVID19 pandemic.

University of the Western Cape	
Data Management Plan	
Faculty	Community and Health Sciences
Department	School of Public Health
Administrative Data	
Project title	Exploring the experiences of antiretroviral medicines supply chain managers in Zimbabwe during the COVID19 pandemic.
Registration details (registration number)	4104268
Funder	Student own funding
Grant number	Not applicable
Abstract - project description (include the research questions)	<p>Background: HIV and AIDS remain a major public health problem globally, in Sub-Saharan Africa and particularly in Zimbabwe. The effective and efficient supply of medicines and medical supplies including ARVs is essential to the provision of HIV treatment and care, including during a public health emergency. The COVID19 pandemic exposed vulnerabilities within public health supply chains that manifested in shortages of medicines, medical supplies, and equipment. Most studies on supply chain experiences and exposures during the COVID19 pandemic are general in scope and span across economic sectors. Very few studies have been conducted in healthcare and social sciences and literature focusing on ARVs supply chain experiences in Zimbabwe during and after the COVID19 pandemic is conspicuously lacking.</p> <p>Aim and objectives: This study aims to explore the experiences of supply chain managers involved in managing ARVs in Zimbabwe during the COVID19 pandemic. It will describe the successes, challenges and lessons learnt in</p>

	<p>managing health supply chains during the COVID19 pandemic in the context of the ART program in Zimbabwe.</p> <p>Methodology: An exploratory descriptive qualitative study will be conducted. An interview guide with open-ended questions will be used to conduct ten (10) in-depth interviews with a heterogenous, non-probability, purposively selected sample of supply chain staff involved in managing the ARVs supply chains at central and provincial levels in the Zimbabwe public sector ART program. Virtual in-depth interviews will be conducted by the researcher using Microsoft Teams, Zoom and Google Meet platforms to provide the interviewer and interviewee convenience. The in-depth interviews will be video recorded. A stepwise approach to data analysis will be used. Recordings will be transcribed followed by manual, thematic coding which will form the basis for analysis and interpretation.</p> <p>Ethics: Ethical approval will be sought from UWC BMREC and permission from the Zimbabwe Ministry of Health and Child Care. Written informed consent will be sought from all participants prior to the in-depth interviews. Ethical risks will be minimised by ensuring confidentiality and participation will be voluntary with the right to withdraw from the study at any time. All personal information will be collected, stored and processed in accordance with the requirements of the Protection of Personal Information Act (Act 4 of 2013).</p>
Principle Investigator (PI)	Tinei Chitsike
ORCID (PI)	Not applicable
Contact details of the PI	Tel: +258 84 320 2866 Email: 4104268@myuwc.ac.za
The timeframe of the research project	September 2023 – August 2024
Date the DMP was created / submitted	09 September 2023
Date /s the DMP was revised	Not applicable
Data	
What will be collected? Describe the data and formats (raw and refined/cleaned/de-identified data).	Qualitative, descriptive/narrative data will be collected through in-depth interviews conducted on Microsoft Teams, Zoom and Google-Meet platforms. Data will be collected as video recordings and transcribed to word text.

When describing formats, please identify storage requirements by (expected file sizes and quantities).	Password protected video recordings and transcribed word text will be stored on researcher's personal computer for five years following which it will be deleted. Ten, 45 minutes to 60 minutes interview recordings will be stored.
Is your data original or will you reuse existing data (or a combination)?	All data will be original.
How will the data be collected? (e.g. interview questionnaire; observation)	Data will be collected through in-depth interviews using an interview guide.
Which software and version will be used?	Zoom version of 02/04/2023 (5.7.6) or Google-Meet 27-01-2022 release or Microsoft Teams of July 16, 2023, will be used to collect data.
Which operating system is used at the time of collecting the data?	Microsoft Dynamics 365.
Documentation (legislation, policies and guidelines)	
Applicable legislation for legal compliance (e.g. Protection of Personal Information Act - POPIA)	Data will be collected, stored, and processed in terms of the requirements of the Protection of Personal Information Act (Act 4 of 2013).
Institutional and funder policies (e.g. UWC RDM Policy)	Data will be collected, stored, and processed in terms of the requirements of the UWC's RDM Policy of March 2021.
Metadata schema and version used (e.g. Dublin Core)	
Descriptive document (How the data was analyzed and how it is used. Upload this document with the data onto the repository)	
Applicable Memorandum of Understanding (MOU) that defines roles and responsibilities for data collection, administration and sharing.	

Ethical compliance and approval	
Provide a description of the research population.	The study population consists of over one hundred health supply chain practitioners involved in supply chain management of antiretroviral medicines in the Zimbabwe public sector ART program. It consists of staff working on various supply chain functions such as product selection, regulation, forecasting, supply planning, procurement, warehousing, and distribution from manufacturers and wholesalers down to health facility level. The study population consists of different professionals such as pharmacists, pharmacy technicians, logisticians, regulators, nurses, and allied health professionals. It spans all levels of the health system supply chain from central through provincial, district to health facility level.
Does this research project require the collection of personal / health related data? Yes /No	No
Does this research project require the collection of sensitive data from private organizations or underaged research subjects? Yes / No	No
Have you received ethical approval Yes (attached letter) / No	Pending
How will you obtain consent?	Information will be provided, and consent will be obtained in writing in the language (English) that the research participants understand and use in their daily work.
In the event you are not able to obtain consent (when data subjects are no longer contactable), how will you proceed?	Not applicable.
How will you handle intellectual property issues?	Intellectual property that is not publicly available accessed during research will be secured and not disclosed to third parties. Intellectual property that is publicly available accessed and used during research will be acknowledged.
How will you manage copyright concerns?	Copyright concerns will be handled in terms of the Intellectual Property Laws Amendment Act 28 of 2013.
How will you manage confidentiality concerns?	Confidentiality concerns will be handled in terms of the Protection of Personal Information Act (Act 4 of 2013) and the National Health Act No. 61 of 2003.
Secure Storage and Backup	
How and where will the primary (raw) data be securely stored?	Primary (raw) data will be kept password protected on the researcher's computer for five years and deleted thereafter.

Where will the refined data be stored?	Refined data will be kept password protected on the researcher's computer for five years and deleted thereafter
How will you share your data with the public?	Primary and refined data will not be shared with the public.
How will you address security and backup?	Primary (raw) data will be kept password protected on the researcher's computer for five years and deleted thereafter. Data will be backed up on an external hard disc drive that will be kept under lock and key.
Are there any structural risks to the secure storage of the data?	No
Data Sharing	
Are there any funder or institutional restrictions on sharing the data?	No
How will the data be shared?	Data will be shared with the UWC SOPH.
How will data be securely shared?	Data will be shared by uploading to secure UWC platforms.
Data Selection, Preservation (Archiving) and Retention	
Which data will be shared?	Raw and refined data, analysis and results will be shared with the UWC SOPH.
What is the long-term storage plan?	Data will be stored securely on the researcher's personal computer for five years and deleted thereafter.