

**A NOVEL SURVEILLANCE FRAMEWORK FOR TRACKING AND
PREDICTING HEALTH OUTCOMES OF CARDIOVASCULAR DISEASES
RISK FACTORS AMONG PEOPLE LIVING WITH HIV INITIATED ON
ART IN KHOMAS REGION, NAMIBIA**

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ABSTRACT

Cardiovascular diseases (CVDs), the leading cause of death in Africa (57%), has recently been recognised as an essential cause of morbidity and mortality among People Living with HIV (PLHIV). Multiple opportunities exist to address the challenges currently encountered with the epidemiological transition and managing the double burden of CVDs and HIV/AIDS. However, there is no documented link between patients' previous visits to antiretroviral therapy (ART) clinics and subsequent meaningful interpretation and analysis of data in Namibia. Critical data on the leading causes of death, notably, CVDs, injuries, drug and alcohol use, and risk factor exposures are lacking. Therefore, the study's purpose was to develop a surveillance framework to enhance the tracking and prediction of health outcomes of cardiovascular diseases risks among PLHIV initiated on ART at health facilities in the Khomas region.

The researcher adopted a mixed-methods approach which was conducted in four sequential phases during this study.

In **Phase I**, a qualitative approach with phenomenological study design was implemented to explore current data management practices of CVDs risk factors among PLHIV on ART. Thirteen key informants selected purposively were interviewed, and data were analysed with ATLAS.ti. The qualitative findings informed the retrospective, cross-sectional, quantitative data collection process. Risk factors data captured between 2004 until 2017 were extracted from 529 patient care booklets (PCB) and matched with the electronic Patient Monitoring System (ePMS) of sampled PLHIV initiated on ART. These data elements were entered and analysed in SPSS version 25 using descriptive statistics with bivariate and multivariate analysis. Fragmented data management practices for CVDs preventative care among PLHIV initiated on ART were one of the major findings of the study.

Phase II involved the process of concept analysis and the development of the conceptual framework based on the findings of Phase I. Schwartz and Kim's hybrid model of concept development was used to identify and analyse main concepts of enabling environment, sound data management practices, and evidence-based health outcomes. The Population Health Surveillance theory and Donabedian's model were

used as a basis for the development of the conceptual framework. The novel surveillance framework was developed in **Phase III**. This phase was primarily guided by the outcome of the study findings and Arthur Samuel's seminal work on the machine learning model of 1959 such as identifying CVDs risk factors; monitoring calculated risks and measuring health outcomes. The framework was evaluated by experts in health, epidemiology, and health informatics to validate its applicability whilst ensuring that the overall study objectives are met. In **Phase IV** the guidelines to operationalise the framework was developed based on the core elements as listed in Phase III above.

The study concluded that the development of the surveillance framework is effective in enhancing the tracking and prediction of health outcomes of cardiovascular diseases (CVDs) risks among PLHIV initiated on ART in the Khomas region. The study made recommendations for policy and operational level health care workers of the Ministry of Health and Social Services, the public health arena, and future research.

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral treatment
BMI	Body mass index
CKD	Chronic kidney disease
CVDs	Cardiovascular Diseases
DHIS2	District Hospital Information System version 2
DRC	Democratic Republic of Congo
EAs	Enumeration Areas
EPI	Expanded Programme on Immunisation
ePMS	electronic Patient Management System
HAART	Highly Active Antiretroviral Therapy
HH	Household
HIS	Health information Systems
HIV	Human Immunodeficiency Virus
IPT	Isoniazid Preventive Therapy
M&E	Monitoring and Evaluation
MoHSS	Ministry of Health and Social Services
MUAC	Mid-Upper Arm Circumference
NCDs	Non-Communicable Diseases
NDHS	Namibia Demographic Health Survey
NGOs	Non-Governmental Organizations
NIMART	Nurse Initiated Management of Anti-Retroviral Therapy
NSA	Namibia Statistical Agency
LMIC	Low-and middle-income countries
PCB	Patient Care Booklets
PHC	Primary Health Care
PHST	Population Health Surveillance Theory
PLHIV	People Living with HIV/AIDS
PrEP	Pre-exposure prophylaxis
PPS	Probability proportional to size
QI	Quality Insurance
SDGs	Sustainable Development Goals
SPSS	Statistical Package for Services Solutions
TB	Tuberculosis
WHO	World Health Organisation

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DEDICATION

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#####

“Ultimately, the secret of quality is love. You have to love your patient; you have to love your profession; you have to love your God. If you have love, you can then work backwards to monitor and improve the system”. Avedis Donabedian (1966)

DECLARATION

I, **Roswitha Mahalie**, at this moment declare that '*a surveillance framework to track and predict health outcomes of cardiovascular diseases risks among people living with HIV/AIDS (PLHIV) in Khomas region*' is a true reflection of my research and all the sources used have been acknowledged in the text and the bibliography. This study has not been previously submitted in its part or its entirety for any other degree to another institution of higher education.

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CHAPTER I: ORIENTATION TO THE STUDY

1.1 INTRODUCTION

Multiple opportunities exist in health facilities enrolling and initiating patients on ART in Khomas health district to enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV started on ART. However, the absence of a robust surveillance framework that supports the need for collecting CVDs risk factors using standard indicators has become a challenge. Due to lack of priority indicators for CVDs, risk factors are not accurately captured using the three key components for NCDs surveillance such as monitoring exposure (risk factors and determinants); outcomes (morbidity and disease-specific mortality), and health system response and capacity (1,2). As a result of this, health data is underused for health planning purposes because of a lack of awareness of data requirements, inadequate data management, uncoordinated data collection, and reporting. In particular, routine data that is collected for CVDs risk factors at ART clinics is rarely used to optimise the health and longevity of PLHIV initiated on ART.

Moreover, the researcher opined that critical parameters such as blood pressure, weight, height, smoking, and alcohol usage history were captured at each client's visit at the ART clinics. Still, only the initial data is entered into the electronic patient management system (ePMS) at the facility level. Anecdotally, data captured for PLHIV initiated on ART are recorded either inpatient care booklets (PCBs), treatment cards, or informal vital signs books at the health facilities in Namibia. Consequently, there is no documented proof that most of this data is used to determine subsequent health interventions for PLHIV initiated on ART. Amidst enormous investments, there is also no evidence of an adequately integrated surveillance framework that routinely

tracks, reports and analyses CVDs risk factors and subsequently predicting health outcomes to PLHIV that are enrolled on ART in the Khomas region.

Although studies have been conducted globally as well as in Namibia on the various risk factors of non-communicable diseases and its co-morbidity with HIV (3–9), studies conceptualising these conditions (10–13) and developing a surveillance framework (14–17) to enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART are very nascent or instead not contextualised. Therefore, this study aimed to develop and describe a novel surveillance framework that enhances the tracking and prediction of health outcomes of cardiovascular disease risks among PLHIV initiated on ART.

This study adopted a mixed-methods qualitative-quantitative sequential research design that was applied in four phases namely, Phase I, situational analysis, Phase II, development of the conceptual framework, Phase III, development and describing of novel surveillance framework and that enhances the tracking and prediction of health outcomes cardiovascular diseases (CVDs) risks among PLHIV initiated on ART in Khomas region, and Phase IV, the developing guidelines to operationalise the framework.

The qualitative findings revealed current practices for recording patient-level data for PLHIV initiated on ART, and highlight the lack of integration of data sources, both for effective patient-centred clinical management and for population surveillance. These findings informed the quantitative data extraction of CVDs risk factors from the

Patient care booklets (PCBs), and ePMS, the construction of a conceptual framework based, and subsequently, the development of the surveillance framework. Notably, the present study comes at a time when syndemics such as CVDs risk factors, HIV infection, and their effect on the health of PLHIV initiated on ART as well as deliberate efforts to streamline targeted health outcomes are gaining recognition.

1.2 BACKGROUND INFORMATION

Cardiovascular diseases (CVDs), the leading cause of death in Africa, has recently been recognised as an essential cause of morbidity and mortality among people living with HIV (PLHIV) (18–22). The UNAIDS report estimated that in 2016 at least 36.7 million people were living with the human immunodeficiency virus (HIV), of which 17.0 million people were initiated on antiretroviral therapy (23). Notwithstanding, several authors confirmed that people living with HIV, whose survival rate has improved drastically, are twice as likely to develop or die from cardiovascular diseases (4,24,25) especially in low and middle-income countries (LMIC) where treatment is unaffordable mainly or unavailable (26–29). Consequently, as more people are initiated on ART, cardiovascular diseases emerge as significant causes of morbidity and mortality globally, even though health interventions are inclined towards the eradication of infectious diseases such as HIV/AIDS (21,30–33).

In a study conducted by Atun et al., it is evident that the evolving new comorbidities such as hypertension, congestive cardiac failure, and strokes put an extra burden on health systems that are ill-prepared to manage the changing disease patterns and multi-morbidity (34,35). As a result, the weight of CVDs have been attributed to the epidemiologic transition, rapid urbanisation, and the increased longevity of

individuals who are initiated on ART (22,36–38). Shah et al., believe that the drastic increase in the global burden of HIV-associated cardiovascular disease over the past two decades resulted in 2.6 million disability-adjusted life years (DALYs) per annum doubling the load in sub-Saharan Africa and the Asia Pacific regions (4). Namibia is no exception to the growing global concern of the double burden of communicable and non-communicable diseases (39).

For example, out of the top 10 causes of death, HIV/AIDS-related deaths were ranked first, followed by stroke, coronary heart disease, and hypertension which are listed numbers two, four, and six respectively among the most prevalent diseases (1,40–43). The World Health Organisation (WHO) further revealed that ischaemic heart disease and cerebrovascular diseases are amongst the top 10 causes of Disability-Adjusted Life Years (DALYs) resulting in an epidemiological transition in Namibia. Of these leading causes of deaths, stroke and Ischaemic heart disease had an upward move in ranking from 8th and 9th in 2000 to 4th and 5th position in 2016 (22,36).

The future risk of non-communicable forms of CVDs such as increased rates of hypertension (29), smoking, and obesity has been rated by several authors as a growing public health concern in Africa (4,5,8,44). Traditional risk factors for CVDs in Namibia include smoking, lack of physical exercise, harmful use of alcohol, unhealthy diets, and obesity (39). Furthermore, the NDHS of 2013, revealed that 44% of women (of which 50.6% were urban dwellers, and 38.3% rural dwellers) and 45% of men (50.8% being urban dwellers, and 37.8% being rural dwellers) aged 35-64 years are hypertensive. It is further revealed that the percentage of women and men who are overweight increases with the age of which urban women (40% versus 22 %) and men

(17% versus 5 %) are most likely to be overweight or obese (45). Besides, the WHO report estimates that Namibia has one of the lowest percentages of people who are engaged in physical activity (66.6%); the highest total alcohol consumption per capita (11.8 litres); and the highest rate of the population aged 15+ years that said they smoked tobacco (33% males; 9% females) (46). The prevalence of hypertension is increasing drastically; therefore, the NDHS recommended that awareness-raising and promoting blood pressure screening may circumvent its adverse effects that result in premature disability and death (45). The NDHS further revealed that the prevalence of hypertension is highest among women and men living in Khomas (56.5% each), while Oshikoto (33.4%) and Kavango (30.4%) reported the lowest prevalence (45). The high prevalence of hypertension in Khomas region warrants and necessitates the development of the surveillance framework in the region.

Research indicates that robust Health Information Systems (HIS) which are an essential backbone for monitoring, tracking, and solving critical health issues globally (47) are needed to ensure credible data at all data-producing levels of any health system. This is critical in developing countries in the Sub-Saharan African region where an estimated 54% of people living with HIV (PLHIV) are currently on antiretroviral treatment (ART), and 45% of these are virally suppressed (48). Additionally, the WHO reports registered that detailed, high-quality data for Sustainable Development Goals (SDGs) and the Post-2015 Development Agenda are not routinely collected resulting in a lack of regular computation of national levels and trends, or disaggregation across crucial dimensions of inequality (42).

The WHO Global Status Report of 2014 also reiterated the importance of establishing functional HIS as well as institutionalising surveillance and monitoring of chronic diseases (2). It is, therefore, clear that demand-driven surveillance and monitoring systems could track risk factors and positively address the double burden of CVDs and HIV/AIDS while appreciating the progress made in achieving health-related development goals. Admittedly, in the Namibian context, tackling issues around data quality and the institutionalised use of information for decision making, the allocation of much-needed resources, and evaluating the effectiveness of health interventions (49) at each data-producing level of the health system will expedite the implementation of the national NCD strategic plan.

In line with evidence from the literature, many stand-alone information systems in the different health directorates have resulted in little sharing of information and poor coordination of inter-ministerial plans and activities' in Namibia (1,2,50). According to the Institute for Health Metrics and Evaluation (IHME), Namibia lacks critical data on the leading causes of death, particularly, cardiovascular diseases, injuries, drug and alcohol use disorders, and risk factor exposures (41). Unfortunately, health systems are not adequately prepared to respond to the growing CVD burden, and their associated risk factors, in Namibia (41). Various healthcare workers such as nurses, pharmacists, doctors, data entry clerks play a significant role in ensuring that PLHIV on ART is registered, vital signs captured, and treatment is given. However, in most instances, the follow-up to measure health outcomes and predict CVDs risks is not prioritised in the Khomas region.

Cardiovascular diseases seem to be presenting a serious threat to the Namibian population amidst subsequent mediocre integrated measurement of health outcomes amongst PLHIV on ART in light of the current poor health infrastructure. Therefore, amid current systemic challenges, the development of a surveillance framework that enhances the tracking of cardiovascular diseases among PLHIV on ART offers an enormous variety of possibilities to respond to health-care challenges. Furthermore, this potentially has a positive influence on the way patients manage their health when accessing integrated healthcare services.

Since evaluation exists at the nexus of science and politics, it is imperative to reconcile the two aspects by monitoring the trends and determinants of CVDs and evaluating the progress in their prevention and control in a scientific manner (51). To address the plight of inadequate surveillance and monitoring systems for tracking CVDs, its associated risk factors, and their outcomes in PLHIV initiated on ART, the researcher opted to use existing programmatic data sources as a springboard for developing an integrated surveillance framework. Through this surveillance framework, tangible health outcomes for CVDs risk factors are tracked, predicted, and measured by using key indicators from the routine ART reporting systems data in the Khomas region.

The first phase of the study-specified outcomes of the situational analysis, whereby the researcher explored current data management practices of CVDs risk factors. The findings of Phase I informed the development of a conceptual framework for the study in Phase II and the surveillance framework in Phase III. In Phase IV, the process of operationalising the framework is discussed.

1.3 STATEMENT OF THE PROBLEM

Cardiovascular diseases (CVDs) have become a leading cause of morbidity and mortality among people living with HIV (1,2,28), yet active surveillance of this condition lag. Comorbidities with CVDs among PLHIV are a considerable problem mainly due to the salient side-effects of ARTs, hence the need for CVDs and its risk factors to be monitored closely to ensure life-long care (28,52). To date, well-documented surveillance of CVDs are limited or rather very rudimentary in most countries (53,54), and Namibia is no exception. Multiple opportunities exist that address the challenges which are encountered with NCDs surveillance and monitoring, their epidemiological transition, as well as ways of managing the burden of both CVDs and HIV/AIDS. However, no documented literature was found in the Namibian context (53). Current evidence shows health systems are not adequately prepared to respond to the growing CVD burden.

Albeit well defined standard operating procedures for data continuum at the facility level, the researcher noted with concern that data analysis, interpretation, and use are tasks that are primarily carried out at higher levels of reporting. These tasks are executed at the expense of all the groundwork that is done at the facility level. Similarly, the researcher has observed that data review meetings are conducted on an ad-hoc basis at higher levels of reporting. Nonetheless, well-documented feedback and action planning to lower levels of reporting are not done. Admittedly, data for CVDs and its risk factors are not used at all levels of the health system nor are CVDs program-specific indicators that specifically address the plight of PLHIV initiated on ART, streamlined, or integrated into ePMS.

Also, the lack of regular data quality checks and audits; centralised data management and analysis tasks; lack of emphasis on the review of data for monitoring and evaluation (M&E) purposes, and irregular dissemination of information (50,55,56) as advocated for by Measure Evaluation, remains a challenge locally. Locally, data quality issues such as cumbersome paper-based systems that rely on multiple registers to track services (50,53,57); nascent culture of data use; delayed feedback; undocumented referral of clients (50) are unprecedented challenges experienced at peripheral reporting levels. Besides, the unavailability and inaccessibility of health statistics pertaining to risk factors for CVDs among PLHIV initiated on ART at the facility level; as well as the movement of PLHIV between different clinics/facilities without institutionalised unique identifiers also contribute to fragmented health service delivery.

Therefore, such a surveillance framework will optimise the tracking and prediction of health outcomes related to CVDs and its risk factors for PLHIV initiated on ART.

1.3.1 Research Question

The aforementioned problem statement, prompted the researcher to seek answers to the following **research questions**: what are the current practices of routine tracking of cardiovascular risks factors data collection, analysis, and reporting and use amongst people living with HIV (PLHIV) on ART?; how can CVDs risk factor data be integrated into existing HIV care and monitoring platforms?; and what surveillance framework can enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART?

These research questions gave rise to the purpose and the objectives of the study.

1.4 THE PURPOSE OF THE STUDY

The purpose of the study was to develop and describe a novel surveillance framework to enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART at health facilities in Khomas region.

1.5 OBJECTIVES OF THE STUDY

The **objectives** of this study were to:

1. conduct a situational analysis of the current practices regarding routine tracking (data collection, data analysis, reporting, and data quality) of risk factors for cardiovascular diseases among PLHIV initiated on ART (Phase I). The **specific objectives** for Phase 1 were to:
 - a) explore and describe health workers' perception of the data management practices of risk factors for cardiovascular diseases among PLHIV initiated on ART (Phase I).
 - b) assess the health risk factors associated with CVDs among PLHIV on ART (Phase I).
 - c) describe patterns of data availability and completeness of CVDs risk factors' data for PLHIV initiated on ART (Phase I).
2. develop a conceptual framework for tracking health outcomes of CVDs risk factors among PLHIV initiated on ART from the findings of the study (Phase II).
3. develop and describe the novel surveillance framework to track and predict health outcomes of cardiovascular diseases risks among PLHIV initiated on ART (Phase III).

4. develop the guidelines to operationalise the novel surveillance framework (Phase IV).

1.6 SIGNIFICANCE OF THE STUDY

Nationally, this study contributes immensely by leveraging existing health platforms to prioritise the tracking of risk factors and predicting possible CVDs of PLHIV initiated on ART as agreed at the September 2011 UN-High-Level Meeting on the Prevention and Control of NCDs with member states in New York (1,58,59). Additionally, this study contributes to the acceleration of reporting and achievement of the UN Sustainable Development Goals for Namibia which refer to ‘good health and well-being’ and the African Commission’s Agenda 2063 of ensuring ‘healthy and well-nourished citizens’ within agreed timelines in a cost-effective manner (60,61).

For the Ministry of Health and Social Services, this study played a significant role in closing the gap of ensuring the provision of regular up-to-date routine CVDs risk factor screening, analysis of integrated, evidence-based CVDs risk factor data, and optimising targeted interventions for PLHIV initiated on ART.

For the health care workers in the Khomas region, gaps were identified and circumvented with the development of the surveillance framework which contributed

to the tracking and linking of PLHIV initiated on ART who are at risk of cardiovascular diseases to ensure that the cycle in the continuum of health care service delivery is not broken. Additionally, the development of a novel surveillance framework to facilitate its implementation



Figure 1.1 Regional Boundaries Map of Namibia (modified by Sergé Elson Muteba,2020)

contributed to a comprehensive multidisciplinary approach for timely health intervention to inform policymaking.

Finally, in the arena of public health, the institutionalisation of CVDs risk factor data collection, consolidation, and usage among PLHIV initiated on ART has contributed immensely to the general body of theoretical knowledge at a programmatic level as well as the academia. Integrated CVDs risk factor data needs and prediction of CVDs risks have been addressed. They are readily available for baseline values for future research, and/or secondary data for further interrogation and analysis.

1.7 DESCRIPTION OF THE AREA OF STUDY

Namibia, which has been classified as a middle-income country, is situated on the south-western coast of Africa bordering the South Atlantic Ocean, between Angola and South Africa, Botswana, and Zambia. At least 57% of the over 2 million Namibian inhabitants live in rural areas. Health services are delivered in the fourteen (14)

administrative regions in Namibia. According to the Demographic Health Profile of Namibia, such areas as

Khomas, Erongo, and //Kharas have the highest urban populations (NSA Population Projections for Health Districts in Namibia, 2011-2015).

There are currently 295 clinics, 47 health centres, 30 district hospitals, three

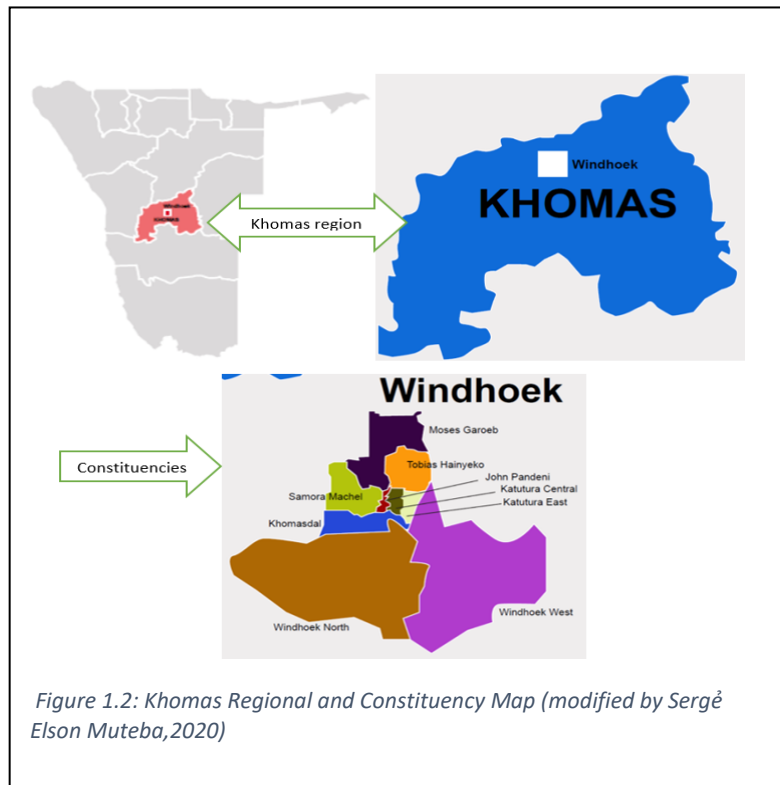


Figure 1.2: Khomas Regional and Constituency Map (modified by Sergé Elson Muteba, 2020)

intermediate hospitals and one national referral hospital, nine sick bays as well as various social welfare service points, private hospitals, and clinics in Namibia (43).

The 14 administrative regions are shown on the map in figure 1.2 below. The current study was conducted in the Khomas region, the most central region in the country, and the capital city of Namibia. The region has a total surface area of 36 861 km² which is about 4.5 % of the total area of Namibia. The overall projected population size is estimated at 379 381 according to the NSA Population Projections for Health Districts in Namibia, 2011-2015. This region bordered by the Otjozondjupa Region on the northern boundary, Omaheke region to the east, Erongo region to the west, and the south is the Hardap Region. The Khomas region comprises ten (10) constituencies namely John Pandeni, Katutura Central, Katutura East, Khomasdal North, Moses //Garoëb, Samora Machel, Tobias Hainyeko, Windhoek West, Windhoek East, and

Windhoek Rural which were all selected based on the locations of the various Primary Health Care clinics as depicted in figure 2 above. The total population size in the Khomas region catchment area is estimated at 447 636 with the following total population size and growth rate per participating facility as presented in table 1.1 below:

Table1.1: Population size and growth per targeted facility (MoHSS, Windhoek health district, 2018)

Name of the health facility	Population size	% growth rate
Groot Aub clinic	11 639	2.6%
Katutura health centre	112804	25.2 %
Khomasdal health centre	34020	7.6%
Robert Mugabe clinic	40 287	9%
Donkerhoek clinic	38497	8.6%
Hakahana clinic	41183	9.2%
Wanaheda clinic	38497	8.6%
Okuryangava clinic	44764	10%
Otjomuise clinic	25068	5.6%
Maxwuilili clinic	25068	5.6%

The MoHSS Health Information Report (2008-2013) indicated that heart failure (including congestive cardiac failure), stroke, intracranial haemorrhage, cerebral infarction, cardiovascular accident, and essential hypertension (primary) were among the top 10 causes of mortality in hospitalised patients in all facilities and all ages in Namibia. In Namibia, the NCDs surveillance system is part of the Directorate of Primary Health Care which falls under Family Health Services. The Family Health Services Division is responsible for non-communicable disease prevention and control, among other services.

1.8 THE PHILOSOPHICAL BASIS OF THE STUDY

Philosophically, this mixed-method study embraced and applied a pragmatic method. In this case, the researcher explored and described practices of routine tracking of the

health outcomes of cardiovascular risk factors data collection, analysis, reporting, and use, which subsequently informed the development of a surveillance framework.

1.9 PARADIGMATIC ASSUMPTION OF THE STUDY

Kuhn as cited in Taylor, Bogdan, and DeVault, defined a paradigm in 1970 as a ‘way of thinking about doing research that rests on assumptions’(62). However, Creswell defines paradigms as one of those critical theoretical blueprints that maps and shapes the researcher’s thinking patterns about a particular phenomenon (63). Similarly, paradigmatic perspectives are referred to by Polit and Beck as looking at natural phenomena from which philosophical assumptions are induced. Furthermore, assumptions usually guide the researcher’s approach to inquiry (64). As such, the pragmatic paradigm was viewed as the most realistic approach since it often focusses on actions, situations, and consequences or causes as opposed to antecedent conditions, argues Creswell (63). Study findings were used to construct specific concepts that expedited the development of the surveillance framework for tracking cardiovascular risk factors among PLHIV initiated on ART and predicting the health outcomes of these patients. The interrelated principles of ontology (the nature of reality), epistemology (the nature of knowing and construction of knowledge), methodology (the process of research), and axiology (morality and ethical considerations) were applied by the researcher in conducting this study (65).

1.9.1 ONTOLOGICAL ASSUMPTIONS

Polit and Beck define ontology as a philosophical element that deals with the nature or essence of being, existence, and reality. Primarily, the reality is understood as subjective. Furthermore, ontology also concerns the area of philosophy that asks what

reality is and what the fundamental categories of reality are (66). In this study, the existence of being and interpretation of reality in a natural setting was based on scrutinising current data entry processes at the facility, district, and national levels (67). These were cemented by subsequent in-depth interviews to get an understanding of what is currently happening on the ground in terms of tracking cardiovascular risk factors and predicting patient health outcomes. Moreover, these preferred objective measures guided the researcher to operationally define specific indicators that ensured validity for the research problem under investigation.

1.9.2 EPISTEMOLOGICAL ASSUMPTIONS

The premise of epistemological assumption is considered as a logical discourse that helps the researcher to gain a better understanding of the theory of knowledge regarding the validation and methods used (68). Additionally, actions that are taken to produce the desired or predicted results (69) are considered. Furthermore, other scholars (Walliman, 2011; Neuman, 2014; Yilmaz, 2013) observe that epistemology focusses on subjectively finding the truth, its value-addition, and validation of this truth (68,70,71). In this study, an interview guide was developed by the researcher to facilitate in-depth key informant interviews that ensured knowledge production at the study site. As emphasised by Teddie and Tashakkori, the epistemological phenomenon exists based on a ‘continuum rather than on two opposing poles’(66). However, quantitative data for CVDs risk factors were extracted from PCBs and ePMS. Thus, no actual interaction with the participants was needed.

1.9.3 METHODOLOGICAL ASSUMPTIONS

Methodological assumptions regarding the process of data collection, analyses, and use of cardiovascular risk factors that are integrated into clinical service delivery of

PLHIV initiated on ART were made by the researcher. According to Creswell, explicit links are established between the research objectives and the summary of findings derived from raw data (72). The researcher applied a mixed-methods cross-sectional, exploratory design approach, which was conducted in four sequential phases. Furthermore, the study employed in-depth interviews using unstructured questions inductively to collect data on health care workers' perceptions and experiences of CVDs risk factors data management practices. Through the qualitative data analysis, patterns and themes were developed that informed the quantitative data collection and analysis process. Subsequently, quantitative data was extracted from the PCBs and matched with individual patient-level data in ePMS. A framework of the underlying structures of experiences and processes that are evident from the raw data was developed. The justification for using the methods is explained in detail in Chapter 3. The study was conducted in the following four phases:

- **Phase I** conducted a situational analysis of the current practices of routine tracking (data collection, data analysis, reporting, and data quality) of cardiovascular diseases among PLHIV initiated on ART.
- In **Phase II**, a conceptual framework was developed as a basis for the development of a framework for the tracking health outcomes of CVDs risk among PLHIV initiated on ART from the findings of the study.
- During **Phase III**, a novel surveillance framework to facilitate the implementation of the framework developed.
- Lastly, in **Phase IV** the guidelines to operationalise the novel surveillance a framework and were developed.

1.9.4 AXIOLOGICAL ASSUMPTIONS

Axiology considers morality and ethical values that embrace specific research principles that guide human conduct during the research process. Such behaviours are concerned with the well-being and respect for research participants. In this instance, the axiological assumption required that the researcher adhered to the ethical standards as outlined in the research protocol, based on approval processes by the MoHSS, and the University of Namibia. To subscribe to universal ethical considerations, the following aspects were considered: Respect for participants' privacy, confidentiality, rights to withdraw from a study, and anonymity.

1.10 UNDERSTANDING THE STUDY PHENOMENON

The adopted study assumptions were all interrelated and responded to the information needs as outlined in the study objectives.

1.10.1 THEORETICAL BASIS OF THE STUDY AND CONCEPTUAL FRAMEWORK/PERSPECTIVES

Kuhn as cited in Taylor, Bogdan, and DeVault defines a paradigm as a 'way of thinking about doing research that rests on assumptions' (65). On the other hand, a theory is explained by Cooper & Schindler in 2014 as a 'set of systematically interrelated concepts, definitions and propositions that are advanced to explain and predict phenomena' (p. 62) (73).

The Syndemic, Population Health Surveillance Theory (PHST) and Donabedian SPO theories served as a foundation for the development of the conceptual framework. Subsequently, the surveillance framework for tracking and predicting risks of CVDs

among PLHIV initiated on ART was developed. The framework development is described in detail in Chapters 5 and 6.

1.11 DEFINITION OF KEY CONCEPTS

The following concepts were adopted and hereafter operational defined:

- **Novel:** is defined in the Oxford Dictionary as something original, fresh, new, different, and unique. In the context of this study, a novel is regarded as a new, fresh way of tracking and predicting CVDs risks among PLHIV initiated on ART.
- **Surveillance:** is an information-based activity involving the systematic collection, collation, analysis, and interpretation of large volumes of data originating from a variety of sources that ought to be disseminated and used for program decision-making. The Merriam Webster dictionary defines surveillance as close and continuous observation or testing (2018). The UNAIDS defines surveillance as public health surveillance which is the ongoing, systematic collection, analysis, and interpretation of health-related data that are needed for the planning, implementation, and evaluation of public health practice (74). Surveillance in the context of this study refers to the three components for NCDs surveillance according to the WHO (1,32,75,76), namely, monitoring exposure (risk factors and determinants), outcome (morbidity and disease-specific mortality), and health system response and capacity. Although health system response and capacity are part of the definition of surveillance, the researcher did not focus on the incorporation of its aspects in the current study.

- A **framework** is defined as a real or conceptual structure intended to serve as a support or guide for the building of something that expands the structure into something useful (11).
- **The surveillance framework for CVDs** of this study denotes a theoretical explanation of tracking and predicting CVDs risks among PLHIV initiated on ART by using three interrelated components, namely *identifying CVDs risk factors*, *monitoring calculated risks*, and *measuring health outcomes* at health facilities in the Khomas region.
- **Cardiovascular diseases (CVDs)** are caused by a cluster of risk factors interacting multiplicatively to promote vascular risk. CVDs such as coronary heart disease, hypertension, stroke, ischaemic heart disease, and cerebrovascular diseases which are among the top 10 causes of disability-adjusted life years in Namibia are inclusive of the operational definition of CVDs (46).
- **Risk factors** are any attribute, characteristic, or exposure of an individual that increases the likelihood of developing a disease or injury. In the present study, the risk factors for cardiovascular diseases included the most commonly recorded non-modifiable, modifiable, and metabolic risk factors such as high blood pressure, overweight/obesity, smoking of tobacco products, alcohol consumption, advanced age, and sex that have the potential of contributing to the development of CVDs among PLHIV initiated on ART (59).
- **People living with HIV/AIDS** are those people who were tested positive for HIV and are initiated on ART according to the UNAIDS terminologies guidelines (74).

- **Antiretroviral therapy (ART):** Antiretroviral therapy is referred to is highly active in suppressing viral replication, reducing the amount of the virus in the blood to undetectable levels, and slowing the progress of HIV disease by UNAIDS (74). This therapy regimens usually includes a combination of three or more different medicines, such as two nucleoside reverse transcriptase inhibitors (NRTI) and a protease inhibitor, two nucleoside analogue reverse transcriptase inhibitors and a non-nucleoside reverse transcriptase inhibitor (NNRTI), or other combinations says the UNAIDS (74).
- **Initiated on ART** refers to PLHIV who are enrolled into the ART programme but is registered to receive life-long monotherapy or dual therapy regimens. The clients who are on Pre-exposure prophylaxis (PrEP) were not considered to meet the criteria of being initiated on ART (74).
- **Integration** means that ‘separate technical services are provided, managed, financed, and evaluated either together, or in a closely coordinated way’(1). The UNAIDS defines integration as the process of joining together different kinds of services or operational programmes to maximise efficiency and outcomes at a programme level and joint planning and budgeting, strategic leadership, and policies at the policy level to strengthen health systems (74). In this study, integration refers to the provision of targeted health care services that will enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART in a coordinated manner to ensure a continuum of care coupled with tangible health outcomes.
- **Health care worker** refers to a cadre of professionals providing health care services to patients and clients. In this study, health care workers are referred

to as medical doctors, nurses, data clerks/administrative assistants, health data managers who provide care, and/ or deals with patient data at any level.

- **Missing data** occurs when a patient decline to answer a question, a data capturer fails to ask or record a patient's parameters or verbal response, or deliberately skips the entry of a parameter or specific response (nd).
- The **availability of data** refers to data and information packages of PLHIV which are readily available without the quality being compromised at any level of the data management process.

1.12 ARRANGEMENT OF CHAPTERS

Chapter 1: Introduction and background.

Chapter 2: Literature review.

Chapter 3: Research design and methodology.

Chapter 4: Presentation of results and discussion.

Chapter 5: Conceptual framework of the study.

Chapter 6: Development and Description of the surveillance framework.

Chapter 7: Guidelines for operationalisation of a surveillance framework for tracking and predicting health outcomes of CVDs risks among PLHIV initiated on ART.

Chapter 8: Conclusions, limitations, unique contributions, and recommendations of the study.

1.13 STRUCTURE OF THE THESIS

This thesis is divided into the following seven chapters, as described below:

In **Chapter 1**, the researcher gives the background information and overview of the study. Subsequently, the statement of the problem, aims and objectives, and the research questions are outlined in this chapter. The significance of the study is also

spelt out, and the definition of terms peculiar to the study is provided. Besides, the section discusses the philosophical basis of the research and the theories upon which the foundations of the surveillance are premised.

Chapter 2 presents a detailed review of relevant literature that is significant to one's understanding of surveillance of cardiovascular disorders risk factors as well as the addressing of information needs and subsequent health outcomes for PLHIV initiated on ART. The chapter also describes specific shortcomings related to cardiovascular diseases, risk factors data collection, and subsequent interventions.

In **Chapter 3**, the researcher gives a more detailed outline of the research design and methodology used in the study. The chapter also describes the study setting and study population. Also, it represents the sampling procedures, and the data collection and analysis methods. Lastly, the ethical considerations, trustworthiness, validity, and reliability of the study are explained.

In **Chapter 4**, the significant findings of the study are presented and discussed subsequently. Relevant data is analysed and presented verbatim and descriptive statistics.

The conceptual framework which guided the development of the surveillance framework is described and developed based on the findings of the study in **Chapter 5**.

Chapter 6 depicts the surveillance framework developed based on the gaps analysis done on the study's findings and current health information systems catering for primary health care and HIV services. The evaluation of the usability of the surveillance framework is also described in this chapter.

The guidelines for operationalisation of a surveillance framework for implementing the framework for tracking CVDs risk factors among PLHIV initiated on ART are discussed in **Chapter 7**.

Conclusions drawn from the primary research findings, study limitations, contributions to the body of knowledge, and recommendations of the study are discussed in **Chapter 8**.

1.14 SUMMARY

This chapter surveyed the epidemiology and trends of risk factors for cardiovascular diseases among PLHIV. The first chapter introduced the reader to the study by providing background information on cardiovascular risk factors, the HIV/AIDS situation, and existing health information systems. The statement of the problem was described, followed by the purpose of the study and its objectives the significance of the study. An elaborate overview of the background of Namibia and specifically the study area was also presented. In addition, the terms conceptualisation and philosophical underpinnings were explained; and theoretical assumptions were addressed. Finally, the key concepts were defined and clarified. A comprehensive literature review of trends of CVDs, co-morbidities of CVDs and HIV, its risk factors, integration of data collection, collation, analysis, reporting, and use among PLHIV will be provided in Chapter 2.

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

The overview of the study and its background, statement of the problem, the purpose of the study, the objectives, and the outline of the different phases of the surveillance framework development were presented in the previous chapter. The literature review sets the stage for any scientific research (77); states the theorem and identifies gaps that are critical to be filled by the outcome of the study (62).

In this chapter, the related literature was reviewed to give context to the study. The review looked at public health surveillance for NCDs zooming in specifically on cardiovascular diseases (CVDs) as well as delineating surveillance, M&E, and the integration of CVDs risk factors data collection within the health fraternity globally, regionally, and nationally. Additionally, the reviewed literature also presents the reader with an orientation on the CVDs burden and its risk factors; the need for integrating cardiovascular disease support into existing HIV platforms, and emerging approaches to data collection that exert a strong influence on the integration of surveillance and monitoring efforts. Moreover, different views of scholars and empirical research were critically reviewed to give a general overview of such efforts and the identification of gaps.

A literature search was conducted on Google Scholar, PubMed, Medline, with no date specified on available literature on surveillance, monitoring, health systems, theories in the context of NCDs, CVDs, HIV, and PLHIV globally as well as in Africa and SSA to identify relevant best practices and gaps. Additionally, Medical Subject Headings (MeSH), free-text terms, and cadre characters such as ‘AND’, ‘OR’, or ‘NOT’ were used to search for defining attributes. The collections of methodological

articles were used to perform additional searches to identify relevant articles on the methodological challenges and frameworks which are discussed in this report.

2.2 BACKGROUND AND CHALLENGES TO SURVEILLANCE

The term surveillance, which is a core function of public health (35), reaches beyond screening and capturing data for health conditions. Surveillance in this study focuses on screening, capturing of data, analysing, and reporting and use of these data elements to enhance integrated health care service delivery (78). Globally, the epidemiological transition from communicable diseases to non-communicable diseases (NCDs) created a double burden for health systems which requires effective surveillance. Consequently, health information systems that are not robust have the potential of struggling to meet the information needs, especially where the burden of CVDs and that of HIV/AIDS is escalating. Dealing with the double burden of CVDs and HIV requires screening and sound data management approaches that are contextually appropriate for resource-limited settings says Breman et al., as cited in Petersen et al., (79,80). Incomplete disease surveillance and record-keeping have been suggested by Behrouz and Gottesman as a major drawback in studying the relationship between HIV/AIDS and CVDs, especially in low-income nations (81). The WHO office in Bangladesh, also reiterated the importance of strengthening of surveillance to ensure the availability of and accessibility to essential information (82). Acknowledging the inherent challenges of standardised processes for surveillance, Salvi et al., underscores the importance of population-level disease registries and surveillance systems to monitor morbidity trends of the major cardiovascular diseases and their risk factors in India (83). In the same vein, Patel et al., also demonstrated the prime importance of improved data collection and surveillance of NCDs among PLHIV in LMICs that ought to inform integrated HIV/NCD care models (79). Furthermore, Letebo and

Shiferaw reason that lack of strong systems for monitoring and surveillance in Ethiopia, resulted in a lack of data to inform policy formulation and designing strategies and programmes (53). Besides, literature has shown, that effective and continuous surveillance of health-risk behaviors, chronic diseases or conditions, health care access, and use of preventive care services is required at health facilities to ensure health information needs are met (12,14,84–87).

In the past, Namibia's focus has been on combating the prevalence of communicable diseases. A classical example is the two-yearly sentinel surveillance to determine the prevalence of HIV among pregnant women visiting ANC clinics. Despite these efforts, not much was done to address the increasing burden of the NCDs, in particular, CVDs among PLHIV initiated on ART in the country. Institutionalised surveillance of CVDs is lagging in Namibia. For example, surveillance efforts started in 2003 when the Ministry of Health and Social Services (MOHSS) conducted a WHO Stepwise survey to screen all patients for noncommunicable diseases (NCDs). However, this survey only focused on steps 1 (demographic data elements questionnaire) and step 2 (physical measurements) according to the MoHSS-PHC focal person. The report of this survey was never published; hence, the need to introduce cost-effective, innovative ways of surveying CVDs risk factors among PLHIV initiated on ART. This underlines the importance of supporting research and surveillance on non-communicable diseases and the timely dissemination of the findings to the health care workers, data managers, policy decision-makers, and the general population (88).

Additionally, MOHSS has embarked upon The Namibia Project for Retention of Patients on ART (NAMPROPA), a quality improvement collaborative to improve

retention, viral load monitoring and suppression, and hypertension screening and treatment among people living with HIV in the Khomas, Ohangwena, and Zambezi Regions in Namibia. The 2018 NAMPROPA report revealed that within six months of implementation, a total of 1,508 ART patients were newly diagnosed with hypertension, of which 854 (57%) were initiated on antihypertensive treatment at the pilot sites (Katutura Health Center, Katutura Intermediate Hospital, Khomasdal Health Center, Okuryangava Clinic, Otjomuise Clinic, Robert Mugabe Clinic, Windhoek Central Hospital).

Before the NAMPROPA implementation in March 2017, 0% of participating sites were routinely doing screening and documenting rates of hypertension screening among ART patients. Between September 2017 and February 2018, 145 patients on ART were newly diagnosed with hypertension, of which 39% were successfully initiated on treatment in the Khomas region, representing a dramatic increase in coverage relative to baseline. However, scale-up for this pilot quality improvement initiative was put on hold due to several system-level implementation challenges such as commodities/supply chain, human resources, and data systems. The use of current systems is further underscored by Nojilana et al., who argues that functional, demand-driven surveillance systems have the potential of addressing key health challenges that are essential to improving health outcomes for CVDs among PLHIV (38).

2.3 USAGE OF SURVEILLANCE SYSTEMS AMONG PLHIV INITIATED ON ART

Multiple opportunities to identify and manage risk factors of CVDs have fallen through the cracks due to the lack of harmonised health information systems locally.

The researcher's own experience cements this notion as an M&E expert in the HIV arena. This observation remains integral amidst the fact that the focus on evaluating and measuring the effectiveness of health and health systems outcomes has increased drastically. In the same vein, WHO is advocating for the introduction of robust health information systems to be part of a well-functioning and resilient health system for active tracking and measuring trends of disease-specific risk factors (1). However, despite such pleas from global health watchdogs such as WHO, parallel systems that meet donor requirements are assumed to be the primary culprits in harnessing efforts of strengthening national health information systems (49). Therefore, establishing yet another parallel system might not be the most ideal choice, especially in the Namibian context which is currently boasting with approximately sixty-six (66) health-related data collection systems (50). However, indicators for ART data are routinely collected and entered at the facility level in the electronic patient monitoring system (ePMS). Therefore, to circumvent the notion of another system the researcher utilised the ePMS as a significant data source for this study.

The electronic patient management system (ePMS), which is considered as the noblest surveillance system for HIV in Namibia as well as the DHIS2 has been instrumental in improving data quality. Still, these systems are facing challenges in consistently producing reliable, timely, and accurate data to demonstrate health outcomes for HIV patients (89). Even though health information systems have shown some positive gains, health systems continue to miss opportunities that ought to strengthen surveillance and monitoring and evaluation of emerging disease-specific risk factors.

Notably, the 2003 World Health Survey Namibia recommended that the Ministry of Health and Social Services start using integrated Health Information Systems to

generate data for monitoring of non-communicable diseases in all administrative regions. These well-established health care platforms for HIV posit to be the ideal springboard for managing individuals with multiple chronic conditions.

Albeit earlier studies mentioned on the adaptation of HIV and NCDs monitoring systems elsewhere, to date, there was very little empirical research done that could guide the notion of developing a surveillance and monitoring framework to support the integration of cardiovascular disease care into existing HIV platforms in Namibia. Therefore, through this research, it is postulated that the well-established health information systems that were mostly geared towards the eradication of HIV/AIDS (90) posit to be the ideal springboard for strengthening surveillance and monitoring systems for emerging CVDs risk factors, its changing disease patterns, and multi-morbidity among PLHIV.

2.4 PRACTICE OF SURVEILLANCE AMONG PLHIV

Ordunez and Hoy define health surveillance as the ongoing systematic collection, analysis, and interpretation of data, tightly integrated with the timely dissemination of this data to those responsible for preventing and controlling diseases (91). These authors advocated for the development of a comprehensive surveillance data platform that acknowledges the potential for a broad set of initiating and propagating risk factors in chronic kidney disease patients. This framework can analyse data, produce useful data and information products (outputs), and improve communication and dissemination (91).

Furthermore, Rice et al., opined that the idea of patient tracking when collecting routine HIV data over time and space creates a workable platform for targeted patient tracing across various health programs (48). One such opportunity is the tracking and linking of CVDs risk factors data for each individual in the PLHIV category, at the facility, district, regional and national levels that will expedite integrated health interventions and outcomes. This cements the notion of using routinely collected data to inform subsequent health interventions based on de-duplicated individual-level CVDs risk factors and to track cardiovascular diseases.

Functional systems play a significant role in achieving the goals and objectives for preventing and managing CVDs (1). Subsequent interventions are possible through the regular monitoring of indicators. For example, WHO has proposed a set of monitoring indicators for CVD prevention, management, and tracking implementation and performance over time whilst ‘allowing for comparison among facilities’(1). It is further stressed that the staff has the liberty to determine ‘how best to integrate data elements into existing data collection systems’(19).

2.5 SURVEILLANCE EFFORTS TO INTEGRATE PUBLIC HEALTH INTO EXISTING CONTROL CVDs

Several endorsements were endorsed such as the Moscow Declaration on NCDs in May 2011, the UN Political Declaration on NCDs in September 2011, the global monitoring framework, and endorsing the WHO Global Action Plan for the Prevention and Control of NCDs (2013-2020) (39,58,59,83). In a study conducted by Nojilana et al., it is recommended that continued effort and political will must be directed towards the prevention or delaying the onset of or treating and managing non-communicable diseases (38,92) through such endorsements. The former Namibian president Hifikepunye Pohamba introduced deliberate efforts to establish and strengthen

multisectoral national policies and plans for the prevention and control of NCDs and developing national targets and indicators (39). All this groundwork led to the launching of The National Multisectoral Strategic Plan for Prevention and Control of Non-Communicable Diseases (NCDs) in Namibia 2017/18 – 2021/22 in November 2018 (39).

Regionally, WHO member states adopted several notions for the M&E agenda which advocates for the strengthening of country-level surveillance systems, as well as integrated surveys into existing national health information systems. These systems are mandated to include monitoring exposure to risk factors, outcomes, social and economic determinants of health, and health system responses, to ensure that the agenda of NCDs are appropriately addressed (75). Following this line of thought, the WHO office in South Africa has committed itself to support surveillance for NCD targets, including a monitoring and evaluation framework for surveillance on NCDs as part of the National Policy on Surveillance between 2015 and 2019 (1).

In a peer-reviewed article on *The Past, Present, and Future of Public Health Surveillance*, Choi claims that ongoing public health information systems are not always integrated with public health surveillance and prevention activities. It is further postulated that poorly coordinated surveillance systems have evolved intending to address case-specific needs which subsequently result in a lack of timely data provision (87).

A survey conducted by Noordam in 2011 on the improvement of maternal health services through the use of mobile phones in LMIC revealed that the challenges in public health services are related to the lack of knowledge and health information that are not always available when they should be (93). The value of this study comes from the assumption that an informed client seeking health when communicating with health providers, has the potential of changing potentially unhealthy behaviour due to the availability of data.

In 2017, MEASURE Evaluation conducted an assessment of data use barriers in the DRC which were highlighted among others as lack of regular data quality checks and audits; centralised data management and analysis tasks; lack of emphasis on the review of data for M&E purposes or programme decision-making and limited or irregular dissemination of information(94). In addition, a study conducted on the influence of HIS Investments on health outcomes in Côte d'Ivoire identified and categorised barriers to data use into real and perceived data quality issues, lack of a data use culture, human resources challenges, and lack of supervision and coordination (49).

An unknown author also revealed in 2014 that the global perspective on integrating mental health into existing HIV healthcare platforms requires the provision of holistic care to all clients regardless of their health sickness condition. To date, strategies and processes focussing specifically on surveillance and monitoring CVDs risk factors among PLHIV initiated on ART are fragmented and not well documented. Hence the researcher's interest in using the same logic, as Bradshaw, Steyn, Levitt, and Nojilana (92) who strongly advocated for the development of a surveillance mechanism that

will capture, track, document, and analyse routine data that are significant for monitoring health outcomes.

2.6 THE SIGNIFICANCE OF INTEGRATING CARDIOVASCULAR DISEASE SUPPORT INTO EXISTING HIV PLATFORMS

For United Nations (UN) member states, to achieve the 66th World Health Assembly target of a 25% reduction of the mortality resulting from NCDs by the year 2025, an integrated approach to health care delivery is required through establishing user-friendly and functional health management systems at existing health delivery points (1). Ebrahim argues that NCDs surveillance should be integrated into existing communicable disease surveillance systems instead of establishing new surveillance systems (37). Atun also supports the significance of developing vital workable solutions that create synergies among investments for existing health platforms to provide integrated patient-centred health services (34). One such viable solution is the adaptation of well-established functional health systems that benefit tremendously from international financing for communicable diseases such as Tuberculosis and HIV related illnesses (31,95,96). Hence, regularly collecting data on the significant modifiable risk factors (such as body mass index, hypertension, blood cholesterol, tobacco use, and physical inactivity) of CVDs among PLHIV initiated on ART may enhance the tracking of trends over time, facilitate projections for policy changes and prevent further escalation of the diseases (97).

In a study conducted by Letebo and Shiferaw on the adaptation of HIV patients and program monitoring tools for chronic non-communicable diseases in Ethiopia, the authors postulate that NCD response using HIV care platforms are improved by facilitating effective interventions based on evidenced-based planning (53). These

authors also established that the absence of standardised patient and program monitoring tools to support NCD services means there is no link between previous client visits at ART clinics and subsequent meaningful interpretation and analysis of data in Ethiopia (53). Although several authors have confirmed that developing countries use the pre-ART and ART registers for patient enrolment onto ART programs, there is no evidence of the existence of a functional surveillance system for aggregating data on CVDs in health facilities (53,55,98).

A Zambian study on adapting HIV patient monitoring tools revealed that there is a strong potential to facilitate the transition from HIV to NCD healthcare systems to meet current demands (67). A holistic approach to the provision of health care service delivery might contribute positively by combating other resource constraints such as staff, materials, and finances. As such, the researcher concurs with many scholars who are advocating for the integration of CVDs management into effective health service delivery for PLHIV.

2.7 TRENDS OF CVDs AMONG PLHIV INITIATED ON ART

Cardiovascular diseases (CVDs), the leading cause of death in Africa (57%), has recently been recognised as an important cause of morbidity and mortality among people living with HIV (PLHIV)(18,34,36,38,99). Bloomfield et al., advised that in low and middle-income countries cardiovascular diseases such as heart failure, hypertension, coronary artery diseases, and stroke among others are common and more prevalent in the HIV-infected population (31). Regionally, from the over 19 million PLHIV in Sub-Saharan Africa, an estimated 54% are currently on antiretroviral treatment (ART) of which 45% are virally suppressed (100). It is implied that the survival rate for these people has improved drastically due to the competent

health management of HIV(37). Namibia is no exception to the growing global concern of the double burden of communicable and non-communicable diseases (39).

In Namibia, HIV/AIDS-related deaths were ranked as the number one cause of the top 50 causes of death, followed by stroke (41,45,101,102). The NCDs are estimated to account for 41% of all deaths locally (101). The proportional mortality of cardiovascular diseases was rated at 17% by WHO in 2018 (101). Coronary heart disease and hypertension were ranked number four and six, respectively, in Namibia's health profile. The WHO further revealed that ischaemic heart disease and cerebrovascular diseases are among the top 10 causes of disability-adjusted life years, resulting in an epidemiological transition in Namibia (1). Consequently, 21% of the proportional mortality are cardiovascular disorders, of which 43% is estimated to account for all deaths related to NCDs locally (1).

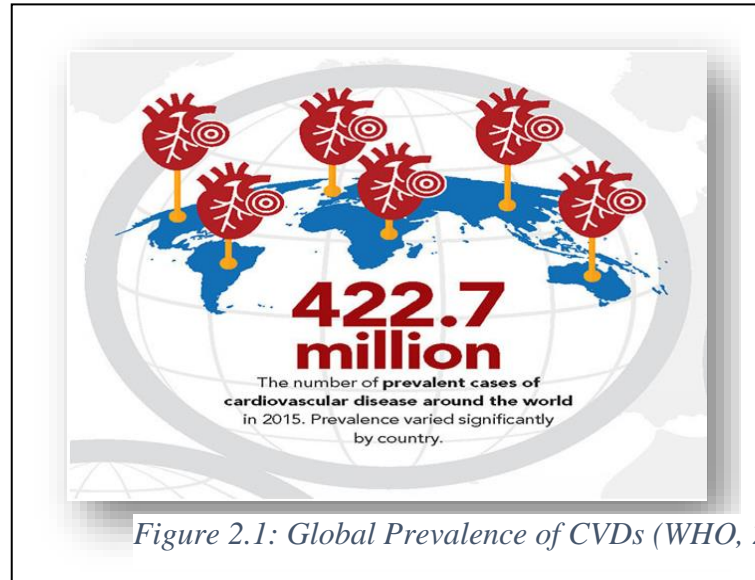
Furthermore, the 2008 Health Services review report revealed that heart failure, hypertension, and stroke collectively were responsible for 5% of all health facility deaths in 2005. The proportion of these cardiovascular deaths grew to 6% in 2006 and 8% in 2007 in Namibia. Similarly, the Namibia 2011 Census Mortality report (NSA), claimed that 77% and 83% of deaths among males and females, respectively, were due to infectious (AIDS and malaria) and degenerative diseases (heart failure and cancer) (103). However, the report admits that further investigations are needed to disaggregate death due to specific illnesses. These trends necessitate the need for improved and integrated surveillance of diseases worldwide.

2.8 GLOBAL TRENDS OF CVDs AND ITS RISK FACTORS

According to the WHO, approximately 17.9 million people die from CVDs annually which amounts to 31% of all deaths globally, of which > 75% of deaths occur in low-

income and middle-income countries (46).

The same report echoes that heart attacks and strokes cause 85 % of these deaths. This report is consistent with the findings of a review on



the epidemiological profile and challenges of cardiovascular diseases in Africa by



Keates et al., who showed that an estimated 1 million deaths were attributable to CVD in sub-Saharan Africa alone. Further analysis of these statistics revealed that CVD-related deaths contributed to 38% of

all NCDs-related deaths in Africa, which translates to 11.3% of all deaths in Africa

(29). The WHO Atlas of African Health Statistics indicates that approximately 3.02 million of the 8.8 million total deaths in the African Region in 2016 were due to NCDs, and these deaths affected more women (1.53 million) than men (1.49 million) (46). The WHO has summed up the burden of cardiovascular diseases as depicted in Figures 2.1 and 2.2, respectively.

The California Health Interview Survey (CHIS) 2011-2012 revealed that CVDs, which are more common among men, accounted for one in three of all deaths in the state with over 78,000 deaths in 2014 (104). Moreover, in India, it is revealed that Ischaemic Heart Disease (61.4 %) and stroke (24.9%) were considered the leading type of cardiovascular disease (28.1%) deaths in 2016 (83).

Data from epidemiological studies such as Framingham play a significant role in the understanding and identification of the multiple interrelated risk factors of CVDs (13,105). In their report, Hagar outlines major modifiable CVDs risk factors as identified by the Framingham study for CVDs, such as 'high blood pressure (BP); high blood cholesterol levels; smoking; diabetes; overweight or obesity; lack of physical activity; unhealthy diet and stress (106). The WHO also reiterates the fact that CVDs have been reported to be triggered by excessive tobacco use, unhealthy food, sedentary lifestyles, and the harmful use of alcohol globally (1).

In a recent study, Sherer et al., established that the prevalence of self-reported CVD risk factors in HIV in Africa is rated at 12% (105). On the other hand, authors like Hattingh, Dreyer, and Roos (2012) believe that the majority of NCDs including CVDs are caused by 'risky health behaviours of the individual, family, and community' (p. 234) while westernisation seems to be the most critical driving force behind its mushrooming. Several other studies confirm that behavioural common risk factors for

CVDs are tobacco use, the harmful use of alcohol, unhealthy diet, and physical inactivity (53,107,108) which leads to metabolic/physiological changes such as raised blood pressure, elevated blood glucose, and overweight and obesity (82,109).

Sardarinia et al., observed that in Tehran, modifiable risk factors account for more than 70% of the risk for both CVD and mortality events. Although modifiable risk factors are controllable, measured needs, demand, seeking, and/or gathering of information are required to do so. However, relatively few health facilities focus on ensuring that risk factor data that is collected is used in terms of effects, consequences, impacts, or outcomes of information seeking (1,92,93,110,111).

In a cross-sectional descriptive study conducted by Olutobi et al., it was found that there was an increased prevalence of cardiovascular disease risk factors among students of a tertiary institution in Ghana (109). For example, through this study, low HDL levels were observed in 32.5% of the students whilst about 45% had high systolic blood pressure, and 32.5% had high diastolic blood pressure. The same study further revealed that CVDs accounted for one-fifth of the causes of death in a 5-year review of autopsy cases at a teaching hospital in Ghana (109), whereby almost every fifth person that died was diagnosed with one of the CVDs (1).

These observations are critical road markers for employing effective treatment and preventive strategies for CVDs, which is predominantly driven by increased rates of hypertension, smoking, and obesity which has become a growing public health concern (29). Interestingly, Hagar postulates that age, gender, family history, and race cannot be controlled alongside efforts of combating morbidity and mortality among people living with HIV.

It is evident that CVDs have become a silent killer, and very little is done to ensure accurate, quality data on which program decision-making could be based. The good news is that CVDs are preventable with targeted, cost-effective, evidence-based interventions such as risk factor controls (37), healthy eating, regular physical activity, and avoiding tobacco (36). Such efforts should be made with the recognition that maintenance of viral suppression is the primary concern as it contributes to CVD risk (20,100,112,113). Sadly, Namibia has the highest rate of tobacco use at 19 percent for men from the age of 21 and 5 percent for women around the age of 34 years (39). An understanding of the epidemiologic transition of CVDs and HIV provides health systems the opportunity to pre-empt the implementation of interventions based on the changing patterns of diseases.

2.9 THE EPIDEMIOLOGIC TRANSITION OF CVDs AND HIV

Forrester, Cooper, and Weatherall, in their epidemiological comparative study, revealed that hypertension was negligible in rural Africans, moderate in the Caribbean whilst the highest prevalence was detected among blacks from United States and United Kingdom (114). Thus, adding the plight of HIV to the fourth category by cementing the premise of the hybrid age. However, a drastic change has taken place whereby hypertension is regarded as the most perilous predictor of cardiovascular diseases.

Statistics from several authors indicate that cardiovascular disease and the prevalence of traditional risk factors has become one of the most prevalent chronic comorbidities for PLHIV enrolled in specific antiretrovirals (42,91,115–117). The literature shows that population dynamics and epidemiological transitions contributed immensely to the evolving new comorbidities such as hypertension, congestive cardiac failure, and

strokes which puts an extra burden on health systems that are ill-prepared to manage the changing disease patterns (20,34,36,38,118).

A study conducted in Uganda reveals that as many as 28% of HAART patients were found to be hypertensive although. However, the ten-year risk of CVD based on the Framingham risk score was relatively low, particularly in women (6,88). Similarly, Dimala et al., confirms in her study on the prevalence of hypertension among HAART patients in Cameroon that blood pressure and other cardiovascular risk factors should be routinely monitored including other factors such as diet, weight control, and physical exercise (119). These risk factors are discussed in detail below.

2.10 RISK FACTORS OF CARDIOVASCULAR DISEASES IN THE AFRICAN REGION

Collins et al., relates risk factors to any attribute, characteristic, or exposure of an individual that increases the likelihood of developing a disease or injury (59). Increased rates of hypertension, smoking, and obesity are predominant drivers of the risk of CVDs, which has become a growing public health concern (18,36,109,120,121). Therefore, in this study, non-modifiable and modifiable, metabolic risk factors such as high blood pressure, overweight/obesity, tobacco, alcohol consumption, advanced age, and sex that have the potential of contributing to the development of CVDs among PLHIV initiated on ART are discussed below in the following sections.

2.10.1 Non-modifiable risk factors

2.10.1.1 Age

Increasing age is proved to be an independent risk factor for hypertension(122). In a study conducted on the patterns of CVDs mortality in Ghana, Sanuade et al., suggest that the proportionate mortality ratio (PMR) for CVDs increased with age, rising steeply in mid-life to peak in the very old, accounting for almost 50% of deaths examined by age 85 years (109). Interestingly, hypertension was significantly associated with older age (above 40 years) and male gender, among people initiated on ART in Cameroon (119). There are currently no documented results classifying age, HIV and CVDs multimorbidity.

2.10.1.2 Sex

A study conducted by Tang et al., revealed that hazardous drinkers were more likely to be male, separated/widowed/divorced, have a monthly household income >NAD 1000, and report less than excellent ART adherence (123). The Namibia Demographic Health Survey (NDHS) correlates with the WHO profile report that more men smoke tobacco than women(42,45). Another study suggests that specifically, men are at more risk of being hypertensive than females (122). Additionally, Bradshaw et al., reported that about 16% of adult men say hazardous/harmful use of alcohol with an increase in recent years (38,92). The 5-year autopsy conducted by Sanuade also revealed that males had a higher proportion of CVD death compared to females (109). According to the latest NDHS 2013, 49% of women and 61% of men are not aware that they have elevated blood pressure. Similarly, to age, there are currently no documented results classifying the sex of PLHIV initiated on ART and CVDs multimorbidity.

2.10.2 Dietary and behavioural factors (modifiable factors)

Physical activity, smoking habits, alcohol consumption, and an unhealthy diet is discussed in the following paragraphs.

2.10.2.1 Physical activity

It is estimated that people who have insufficient physical activity have a 20% to 30% increased risk of all-cause mortality compared to those who engage in physical activity. In 2016, the WHO African Region ranked second in physical activity after the Western Pacific, with 78% of the population estimated to be physically active. This means that up to 22% of the African people of about 223 million people in the African Region were physically inactive in 2016. People in Uganda were physically more active than elsewhere in the region, with 94.5% of the population estimated to be physically active in 2016, followed by Mozambique (94.4%), Lesotho (93.7%), the United Republic of Tanzania (93.5%), Togo (90.2%) and Sierra Leone (85.7%). Mauritania had the lowest percentage of people engaged in physical activity, with only 58.7% estimated to be physically active in 2016, followed by Mali (59.6%), South Africa (61.8%), Namibia (66.6%), and Algeria (66.4%). Males in the African Region were more physically active than females, with 81.6% of males being active compared to 74.4% of females.

2.10.2.2 Use of tobacco products

Currently, cigarette smoking is the most powerful predictor of CVD events among patients with HIV(118). In 2015, for instance, the percentage of adults 15+ years in the African Region who smoked tobacco ranged from 3.1% to 20.6% with a median of 10.3%. Lesotho had the highest percentage of the population 15+ years that said they smoked weed in 2015, followed by Sierra Leone (19.4%), the Republic of Congo (17.4%), Namibia (17.2%), and South Africa (17.0%). Ghana had the lowest rates,

followed by Ethiopia (3.2), Nigeria (4.6%), and Niger (4.7%). Tobacco is smoked predominantly by males, with rates of tobacco use among females ranging from 0.1% to 0.7% only(46). In Lesotho, males smoked tobacco up to 129 times more frequently than females. According to the 2014 Global report on tobacco use, 12% of all deaths among adults aged 30 years were attributable to tobacco use (46).

The Namibian government introduced the Tobacco Control Act (Act No. 1 of 2010) aiming at intensifying the control of tobacco products. This was done through the introduction of legal instruments such as labelling of tobacco and prohibiting the sale of tobacco to minors. The Working Group on the Prevention Strategies for Cardiovascular Disease in HIV-Infected reasons that cigarette smoking is highly prevalent among patients with HIV (47% to 71%) than in general (118). Interestingly, the 2013 NDHS revealed that approximately 12.7% of women and 2.6 % of men smoke tobacco products daily in the Khomas region.

2.10.2.3 Harmful use of alcohol

According to the WHO report, it is estimated that Namibia and Uganda have the highest total alcohol per capita consumption (11.8 litres), followed by Equatorial Guinea (11.6 litres), Rwanda (11.5litres), and South Africa (11.2litres) (46). The report compiled by Tang et al., on the Alcohol-Related Electronic Screening and Brief Intervention (eSBI) Program to Reduce Hazardous Alcohol Consumption in Namibia's Antiretroviral Treatment (ART) Program, revealed that poor adherence and retention in care among people on antiretroviral therapy (ART) are attributed to the harmful use of alcohol (123) which eventually results in an estimated 3.3 million deaths globally (46). The report further reveals that of the 787 participants who participated in the study, 45% reported some alcohol use in the past 12 months and

25% reported hazardous drinking levels. Hazardous drinkers were more likely to be male, separated/widowed/divorced, have a monthly household income > NAD 1000, and report less than excellent ART adherence (123). Heavy alcohol use among PLHIV is a significant public health concern because it is associated with an increased risk of HIV transmission through diminished personal control and increased likelihood of engaging in unprotected sexual activity (2,13,124).

2.10.2.4 Dietary patterns

Several authors have confirmed the association between diet and CVDs (112,118,119,125). In an article reviewing seven studies on the association between dietary fiber and CVDs, an inverse association was found in six of the seven studies. Women are at greater risk of CVDs than men because of their smaller bone structure, hormonal changes, and pattern of bone loss.

There is currently little documented information about the composition of the diet of the Namibian population. Nutrition problems are of concern to the Namibian nation (126). Findings from standalone studies could therefore not be generalised to CVDs among PLHIV initiated on ART. According to the National Health Policy Framework 2010-2020, HIV/AIDS can cause reduced food consumption, interfere with food digestion and absorption. In a survey among PLHIV (2008), 20.1% were found to be undernourished (BMI <18.5), and 2.5 percent were severely malnourished (BMI <16).

2.10.3 Metabolic factors/physiological changes

Hypertension raised blood sugar, elevated blood lipids, and overweight/obesity are discussed as metabolic factors or physiological modifications below.

2.10.3.1 Raised blood pressure (Hypertension)

Several studies acknowledge antiretroviral-associated hypertension as an entity among PLHIV initiated on ART (8,28,81,112,127). Hypertension, which is easily detected at any health facility, has been identified as the most prevalent risk factor for CVD globally (68). The criteria for hypertension endorsed by the American College of Cardiology and American Heart Association (ACC/AHA) were used to classify hypertension as follows:

- Elevated blood pressure: Systolic BP (SBP) 120-129 mmHg or diastolic BP <80mmHg;
- Stage 1 high blood pressure: SBP 130 to 139 mmHg or DBP 80 to 89 mmHg
- Stage 2 high blood pressure: SBP \geq 140 mmHg or DBP \geq 90 mmHg (95).

In a South African study conducted by Hyle et al., (2019) on cardiovascular risk factors among ART-experienced people with HIV, a fourth option was added which is a hypertensive crisis (SBP \geq 180 mmHg or DBP \geq 110 mmHg)(128).

Stein et al., suggest that ART may be associated with a modest increase in blood pressure and the prevalence of hypertension subsequently (95). According to Singh, Shankar, and Singh, hypertension seems to be a significant contributing factor that makes people vulnerable to several chronic diseases and other unbearable health consequences (122).

The Atlas of African Institute stipulates that the prevalence of increased blood pressure among adult males with 18+ years ranged from 22.7% in Nigeria to 31.8% in Mauritania, with a median of 28.0% in 2015 (46). Among adult females, it ranged from 20.2% in Seychelles to 35.8% in Niger with a median of 28.4% (46) report.

The NDHS of 2013, revealed that 44% of women (50.6% urban, 38.3% rural) and 45% of men (50.8% urban, 37.8% rural) aged 35-64 years are hypertensive. The WHO global health report indicates that on average, close to 28% of adults with 18+ years in the Region have raised blood pressure which is defined as systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg.

2.10.3.2 Raised blood sugar (diabetes mellites)

The WHO has revealed that 7% of the population in the WHO African Region has raised blood glucose, defined as a fasting plasma glucose value ≥ 7.0 mmol/L (126 mg/dl); or are on medication for raised blood glucose. In 2014, the prevalence of raised blood glucose ranged from 4.2% in Burundi to 13.0% in Mauritius, with a median of 7.1.0%. This is slightly higher than the prevalence in 2010, which ranged from 3.7% in Burundi to 12.5% in Mauritius, with a median of 6.6% (46).

2.10.3.3 Raised blood lipids

Recent WHO estimates for blood cholesterol in the WHO African Region are not available but by 2008, up to 23.1% of adults ≥ 25 years in the Region (range: 15.2% – 57.7%) had raised total blood cholesterol, defined as total blood cholesterol value ≥ 5.0 mmol/l. The male-female difference was considerable, with the prevalence rate higher among females (24.8%) than males (21.2%). This difference was retained in all but two countries: Mauritius (males 47.8% and females (46.0%), and Seychelles (males 59.1%) and females (55.3%). Seychelles had the highest prevalence of raised total cholesterol (57.7%), followed by Mauritius (47.1%), Gabon (42.5%), and Equatorial Guinea (40.9%). The prevalence was lowest in Niger (15.2) followed by DRC, Liberia, and Sierra Leone (all at 16.1%) (46).

2.10.3.4 Overweight and obesity

Overweight and obesity trends worldwide are of primary concern because of the several associated health complications, including high blood pressure, stroke, heart disease. In a study conducted by Bailin, Gabriel, Wanjalla, and Koethe on *obesity and weight gain in persons with HIV*, it is revealed that these risk factors compound an increasing burden of the metabolic disease once PLHIV is introduced to ART(5). Witter et al., on the other hand, revealed that excess body fat increases the risk of developing a range of health problems, including high blood pressure, diabetes mellitus, and CVD (129).

The prevalence of overweight and obesity is calculated by an individual's body mass index score(129). The American Heart association reasons that BMI is considered as the numerical value of your weight in relation to your height (95). This association further suggest the following calculation for BMI:

- between 18.5 and 25 kg/m² indicates a normal weight.
- less than 18.5 kg/m² is considered underweight.
- between 25 kg/m² and 29.9 kg/m² is considered overweight, and,
- of 30 kg/m² or higher is considered obese.

The same classification was used tailor-made and adapted to determine the association between BMI and variables such as hypertension and sex, for example. Similar measurements were used by Dimala et al., who conducted a hospital-based study on the prevalence of hypertension in HIV/AIDS Patients on Highly Active Antiretroviral Therapy (HAART) in Cameroon (119).

In Namibia, the NDHS of 2013 revealed that the percentage of women and men who are overweight increases with the age of which urban women (40% versus 22 %) and men (17% versus 5 %) are most likely to be overweight or obese (45). Since the year 2000, the proportion of the population 18+ years that are either overweight (BMI 25-29.9) or obese (BMI 30 or higher) has increased to 38.4%, and from 28.4% in 2000 to 41.7% in 2016. It is estimated that in 2016, 54.1% of women compared to 28.4% of males were either overweight or obese, with the lowest prevalence of obesity or overweight among adults 18+ years being 61% for males and 56% for females (46). However, no documented studies that investigate obesity and its effect on HIV disease progression could be found in the Khomas region.

Theoretical perspectives discussed below guided the conceptualisation as well as the development of the surveillance and monitoring that enhances the tracking of CVDs risk factors among PLHIV initiated on ART.

2.11 THEORETICAL BASIS OF THE STUDY AND CONCEPTUAL PERSPECTIVES

The study adopted several interrelated theories and/or models to inform the development process of conceptualisation, and subsequently, the surveillance framework to enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART. These theories are described below.

2.11.1 SYNDEMIC THEORY

Singer and Clair hypothetically define the Syndemic theory as “two or more epidemics interacting synergistically and contributing, as a result of their interaction, to excess burden of disease in a population” (p. 425) (124,130,131). The Syndemic theory was adopted to guide the development of the conceptual framework. This theory positioned

the researcher firstly, to recognise possible biological interactions between two diseases for a syndemic to occur (HIV, being initiated on ART and development of common risk factors for CVDs); secondly, to describe under what circumstances diseases interact (the ability of the health system to screen and detect CVDs risks among PLHIV initiated on ART) and what can be done to intervene; and lastly, to intervene in ways that address social and medical conditions aimed at facilitating integrated continuum of care to PLHIV on ART (proposing a health framework that encourages early detection and control of CVDs and integrated health care provision to PLHIV initiated on ART). These three notions were applied during the process of data collection and analysis. Despite the existence of comorbidity between HIV and CVDs, the significant finding of this study garnered from the qualitative interviews revealed that basic the parameters are measured from PLHIV initiated on ART; these parameters are recorded in the patient care booklets (PCBs) and the electronic patient monitoring system (ePMS); however, the quantitative process of data extraction found that the missing value patterns are more inclined towards alcohol, smoking, and those at risk of increased BMI. Figure 2.3 below depicts the application of the Syndemic theory in this study.

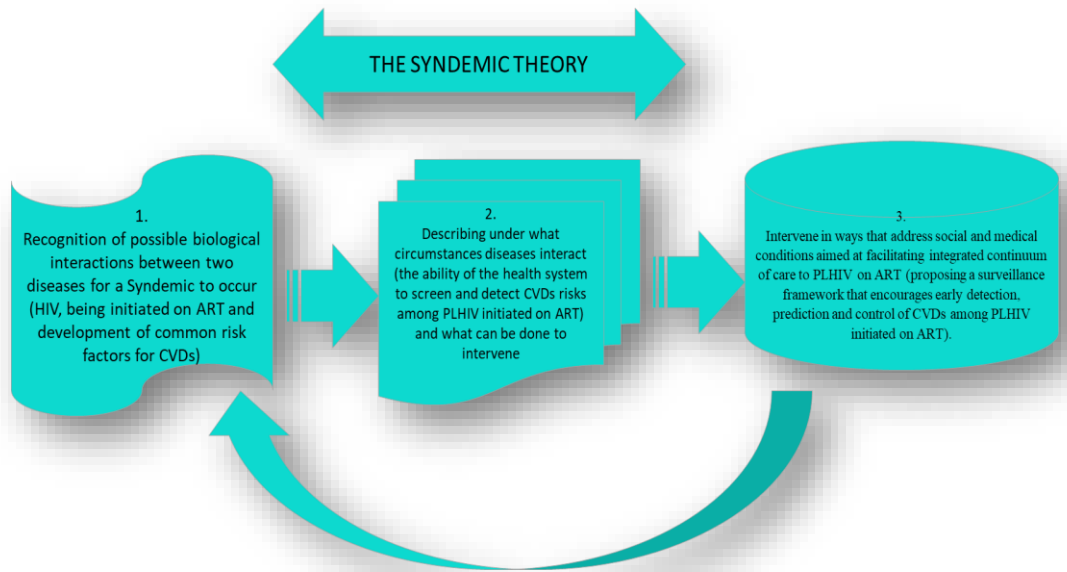


Figure 2.3: Application of Singer and Clair’s Syndemic theory (Mahalie, 2019)

2.11.2 OMRAN’S EPIDEMIOLOGICAL TRANSITION THEORY

This study draws from the work posited by Omran in 1971 on the epidemiological transition theory, which presents a plausible sequence of transformations in a population’s health over the life course. According to this theory, significant shifts in economic, demographic, and social environments consistently contribute to changing patterns in health and disease in any given country (132,133). Omran’s seminal work which was improved by Levenson et al., postulates that all societies experience the following three "ages" and disease profile in the process of modernisation as depicted below in Figure 2.3 (132–135).

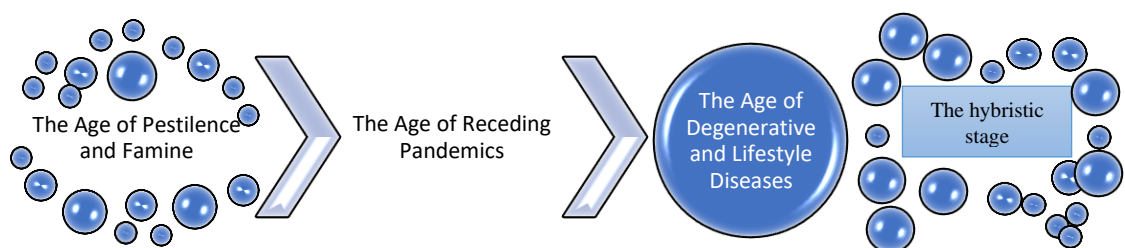


Figure 2.4: Modified Omran’s Epidemiological Transition Model (Mahalie, 2019)

- During the "age of pestilence and famine" incidences of mortality were high and at times fluctuating mainly due to childhood and other infectious diseases with an average life expectancy of under 30 years.
- The "age of receding pandemics", was met with a rise in life expectancy due to improved economic, demographic, and social environments, and public health infrastructures.
- The "age of degenerative and man-made diseases", contributed to an enormous rise in mortality resulting from the disappearance of infectious diseases and the sharp increases in the incidences of degenerative diseases and human-made diseases. Unhealthy dietary patterns mainly fuel this age, sedentary lifestyle habits, high body mass index, raised blood pressure, blood sugar, and cholesterol levels.
- Rogers and Hackenberg introduced a "fourth stage" which is increasingly influenced by individual behaviours and lifestyles. The successes and advances made, for example, in cardiovascular diseases' diagnoses and treatment resulted in a relatively stagnant life expectancy at the point of convergence (134).

According to Mercer, infectious diseases are some of the precipitating factors that contribute to the development of non-communicable diseases. Remarkably, Mercer moved beyond the original underpinnings of the Omran health transition model by including health systems response to changing patterns of conditions (133). Unhealthy dietary habits and changes in lifestyle as alluded to in stages three and four have a direct contribution to the escalating occurrence of CVDs risk factors in society. Since the researcher has a vested interest in syndemics of CVDs and HIV, the underpinnings

of health systems response and its ability to measure CVDs health outcomes for PLHIV initiated on ART, the epidemiological transitions as proposed by Mercer also laid the basis for this study.

2.11.3 POPULATION HEALTH SURVEILLANCE THEORY (PHST)

The theoretical concept, as proposed by El Allaki, Bigras-Poulin, Michel, and Ravel is considered as an explicit theory that helped explain and organise the surveillance process (17). This theory amplifies fundamental critical underpinnings such as the methodological know-how of practices and secondly, determining the rules systematically connecting surveillance concepts while predicting the appropriateness and acceptability of a surveillance programme (17).

The development of a conceptual framework for this study was also guided by the five sequential interrelated steps as proposed by El Allaki et al., such as a trigger or need; problem formulation; surveillance planning; surveillance implementation as well as information communication and audit. These steps as applied in this study are depicted in figure 2.5 below.

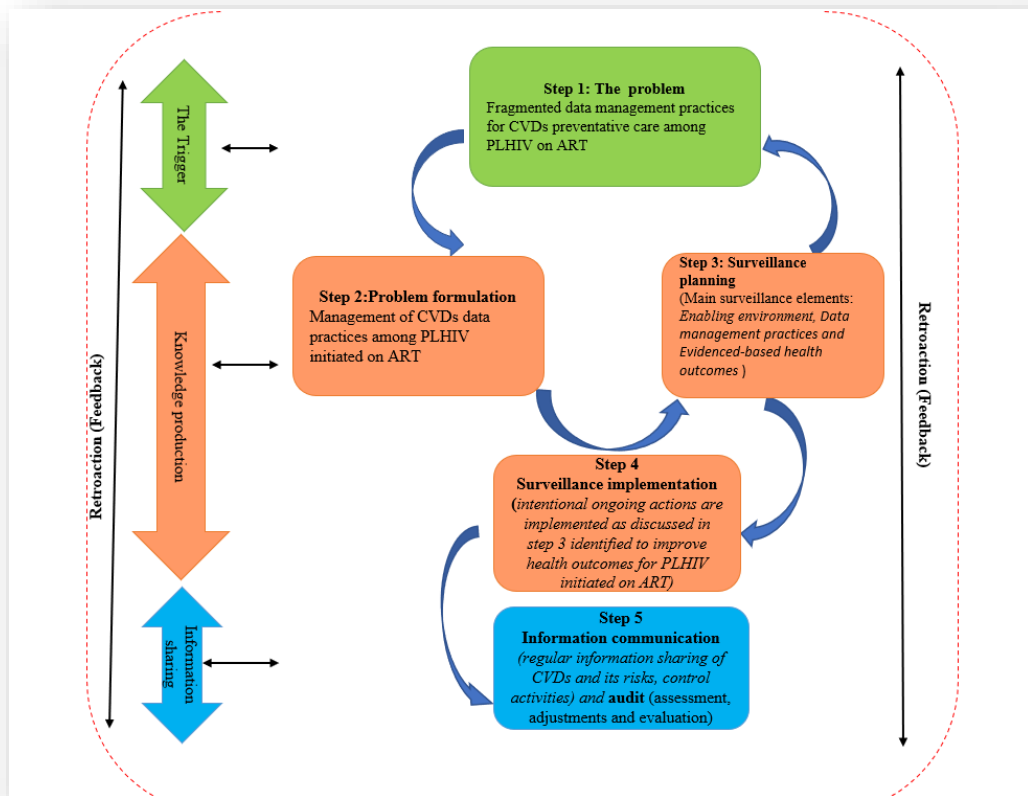


Figure 2.5: Modified application of El Allaki's et al., PHST (Mahalie, 2019)

The framework aimed to conceptualise generic concepts that would enhance the integration of routine tracking of risk factors for CVDs risk factors and to predict and measure subsequent health outcomes among PLHIV initiated on ART in the Khomas region.

2.11.4 AVEDIS DONABEDIAN'S SPO MODEL

The Donabedian model is known for its flexibility to be applied in diverse health settings such as improving patient flow or information exchange, the quality of chronic disease management, and measuring health outcomes at any level of implementation. Furthermore, the Donabedian model postulates that the focus on structures and processes enhance the measurement of health outcomes that will improve quality health care (136–138). The three elements of the Avedis Donabedian's (1966) SPO

models such as **structure** (resources), **process** (clinical activities), and **outcomes** (the desired result of healthcare) (10,137,139) were incorporated into the conceptual framework by the researcher in Chapter 5.

The structural attributes included stakeholders (healthcare workers, PLHIV initiated on ART); environment (Primary Health care facilities); material resources (infrastructure and equipment); services (ART programme operating in an enabling environment); health care system culture (organisational values, change management, mentoring and bi-directional referral); and existing legislation (multisectoral NCDs strategic plan, guidelines, and operational procedures).

The second element, referred to as process involves the screening and recording of CVDs risk factors for all PLHIV initiated on ART in institutionalised systems as well as collation and analysis of risk factor data to facilitate prompt diagnosis and treatment. The third element included expected outcomes such as increased capacity (knowledge), and overall health status change (increased survival, decreased mortality, decreased morbidity) of PLHIV initiated on ART.

2.11.5 ARTHUR SAMUEL'S MACHINE LEARNING MODEL

Lastly, Arthur Samuel's seminal work on the machine learning model of 1959 was also incorporated into the abovementioned models to develop the surveillance framework for tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART. According to Arthur Samuel, computers can be given the ability to learn without being explicitly programmed (140). Therefore, the researcher deemed it necessary to use Samuel's tailor-made tenets such as surveillance of risks for CVDs; monitoring calculated risks and evaluated measured CVDs outcomes

among PLHIV initiated on ART to outline the sequence and structure of the surveillance framework as depicted below in figure 2.6.

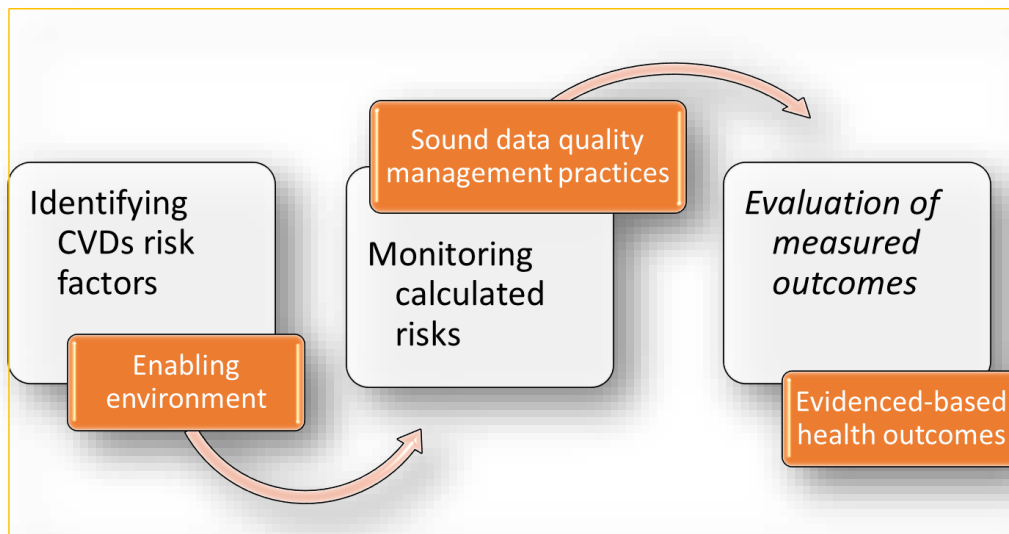


Figure 2.6: Samuel's tailor-made tenets used for developing the surveillance framework (Mahalie, 2019)

This model is particularly useful because it highlights critical areas in the context of the WHO key components of NCDs surveillance such as monitoring exposure (risk factors and determinants), outcome (morbidity and disease-specific mortality), and health system response and capacity (1,46,55).

These theories/models, together with the findings from the study, were utilised to develop the conceptual framework that will enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART.

2.12 METHODOLOGICAL PERSPECTIVES

The researcher employed mix-methods such as qualitative and quantitative, exploratory, descriptive, and contextual cross-sectional study designs that were used sequentially. Most previous studies conducted on CVDs risk factors and HIV/AIDS

interventions were cross-sectional, used multivariate analyses, conducted key informant interviews, and/or have collected data retrospectively to explain a specific phenomenon. Similarly, traditional risk factors for CVDs among PLHIV were used as outcomes or covariates. Purposive sampling techniques were mostly applied. The following are a few examples of studies employing various study designs and statistical analyses.

Ofiri et al., (2018) conducted a cross-sectional descriptive study that found an increased prevalence of cardiovascular disease risk factors high cholesterol level (32.5%), high systolic blood pressure (45%), and high diastolic blood pressure (32.5%).

In another study, Parienti et al., conducted a cross-sectional evaluation on the cessation of tobacco smoking among all consecutive HIV-infected patients in an outpatient consultation in France in 2017(44). This study included a univariate analysis with χ^2 , student t-test, or Wilcoxon tests followed by multivariate analysis with logistic regression models. A p-value < .05 was considered to denote statistical significance (44).

A cross-sectional, observational study of CVD risk factors at baseline by Friis-Møller included data on demographic variables, cigarette smoking, diabetes mellitus, hypertension, dyslipidaemia, body mass index, stage of HIV infection, antiretroviral therapy. This study found that HIV-infected persons exhibit multiple known risk factors for CVDs (112).

Another cross-sectional facility-based study on comorbid non-communicable diseases among adults living with HIV infection in Zimbabwe conducted by Magodoro et al.,

revealed in 2016 that hypertension [10.2 %; (95 % CI 8.4–12.2 %)], and congestive cardiac failure [1.5 % (95 % CI 0.9–2.5 %)] were identified as strongly associated with comorbidities among female PLHIV the age group of 45 to greater than 55 years (9).

Moreover, Opare et al., employed a descriptive design using secondary data analysis and key stakeholders' interviews to assess the surveillance system of selected NCDs (hypertension, diabetes, bronchial asthma, and sickle cell disease). These authors have included data variable-groups such as socio-demographic data (age, sex, occupation, place of residence), morbidity and mortality data on NCDs at health facilities and district levels in Ghana (110).

Cardiovascular risk factors in urban areas, for adult, Malawian ART patients were determined through a cross-sectional study. This study employed multivariate analyses which postulate that higher age was associated with low physical activity, raised blood pressure, being overweight, and increased waist-hip ratio (113). The study further found the highest prevalence of hypertension (44.4%) among those people on a combination of antiretroviral therapy for more than five years (113).

A novel prospective surveillance model (PSM) for rehabilitation after breast cancer treatment was developed by Gerber et al., in 2012. The model proposed 'a standardised framework for interval assessment from the point of breast cancer diagnosis through survivorship to promote early identification and intervention for physical impairments that may impede a patient's functional ability'(141).

Furthermore, a population-based cohort study among Danish people by Obel et al., revealed that HIV-infected patients receiving HAART have an increased risk of ischemic heart disease, and are most likely to be hospitalised with a substantially higher adjusted relative risk of 2.12 at a 95% confidence interval (142). This study used Cox's regression to compute the hospitalisation rate ratio as an estimate of relative risk, adjusting for comorbidity (142).

In the retrospective cohort study, cardiovascular disease-related mortality in the Asian-Pacific was mainly attributed to older age (3.58 for 41-50 years and 8.91 for \geq 51 years). Other treatable risk factors included high blood pressure (1.04–2.52), triglycerides (1.02–2.37), total cholesterol (1.27–2.82), and BMI (1.12–2.46) at an incidence rate of 6.2 per 1000 person-years (PY) (143).

2.13 FRAMEWORK DEVELOPMENT PERSPECTIVES

Notwithstanding, the several studies that were conducted on the epidemiological transition and multimorbidity of HIV and CVDs globally, to date very little empirical research, has been done to guide the notion of developing a surveillance framework to support the integration of cardiovascular diseases care into existing HIV platforms in Namibia.

Witter et al., developed a framework for monitoring and managing modifiable risk factors for cardiovascular diseases among Indigenous-Fijian and Indo-Fijian subgroups in Fiji. However, their focus was on the general population and not specifically on multimorbidity of CVDs and HIV(13).

Ordunez and Hoy developed a comprehensive surveillance data platform that can initiate and propagate risk factors in chronic kidney disease (CKD) patients(144). This

framework can analyse data, produce sufficient data and information products (outputs), and improve communication and dissemination (144). Similarly, to the Witter framework, Ordunez and Hoy focussed on the general population and not on ways of disaggregating CKD and HIV data management.

All WHO member states adopted several notions under its M&E agenda which advocates for the strengthening of country-level surveillance and monitoring systems. Such efforts should have the potential of monitoring exposure to risk factors, outcomes, social and economic determinants of health, and health system responses, to appropriately address the NCDs agenda (75). Besides, the WHO has proposed a set of monitoring indicators for CVD prevention, management, and tracking implementation and performance over time but interestingly, has stressed that the staff has the liberty to determine ‘how best to integrate data elements into existing data collection systems’(1).

Ebrahim argues that NCDs surveillance should be integrated into existing infectious disease surveillance systems instead of establishing new (37).

Furthermore, Atun (2013) reiterates the significance of developing vital workable solutions that create synergies among investments for existing health platforms to provide integrated patient-centred health services(34).

Meanwhile, Bradshaw, Steyn, Levitt, and Nojilana also advocates for the development of a surveillance mechanism that will capture, track, document, and analyse routine data that are significant for monitoring health outcomes (92).

Thankappan et al., underscored the notion that regularly collecting data on the major modifiable risk factors (such as body mass index, hypertension, blood cholesterol,

tobacco use, and physical inactivity) may enhance the monitoring of trends over time, facilitate projections for policy changes and prevent further escalation of CVDs among PLHIV initiated on ART.

2.14 SUMMARY

This chapter reviewed relevant literature in terms of current trends of data use, storage, and feedback provided on CVDs risk factors among PLHIV on ART. Limited research is available on the development of a surveillance and monitoring framework in most countries. It has been realised that ongoing public health information systems are not always integrated with public health surveillance and prevention activities thus compromising integrated patient-centred health services. Finally, since this study was the first of its kind in Namibia, it argues that monitoring exposure to CVDs risk factors, measuring health outcomes and timely health system responses for the strengthening of country-level surveillance systems is critical. The study's methodology will be discussed in detail in the next chapter.

CHAPTER 3: RESEARCH DESIGNS AND METHODOLOGY

3.1 INTRODUCTION

The previous chapter identified, selected, and critically appraised literature related to this study. This chapter presents the research designs, methodologies, and approaches used in the development of a novel surveillance framework for tracking and predicting health outcomes of CVDs risks among PLHIV initiated on ART in the Khomas region.

The goals of the study were achieved through the following objectives:

- conducting a situational analysis of the current practices of routine tracking (data collection, data analysis, reporting, and data quality) of cardiovascular diseases among PLHIV (Phase I). This phase was achieved through the following specific objectives:
 - ✓ Exploring and describing health workers' perception of the data management practices of risk factors for cardiovascular diseases among PLHIV initiated on ART (qualitative).
 - ✓ Assessing the health risk factors associated with CVDs among PLHIV on ART (quantitative).
 - ✓ Describing patterns of data availability and completeness of CVDs risk factors' data for PLHIV initiated on ART (quantitative).
- developing of a conceptual framework for tracking health outcomes of CVDs risks among PLHIV on ART from the findings of the study (Phase II)

- developing and describing the novel surveillance framework to track and predict health outcomes of cardiovascular disease risks among PLHIV initiated on ART in the Khomas region (Phase III).
- developing the guidelines to operationalise the novel surveillance framework (Phase IV).

3.2 STUDY OVERVIEW

The chapter outlines the study overview which consisted of four phases namely, Phase I, situational analysis, Phase II, development of the conceptual framework, Phase III, development of a novel surveillance framework, that enhances the tracking and prediction of health outcomes of cardiovascular diseases (CVDs) risk among PLHIV initiated on ART in Khomas region, and Phase IV, guidelines to operationalise the surveillance framework. The aspects of reliability and validity were examined, and relevant ethical considerations of the study are detailed concerning informed consent, respect for persons, beneficence, and distributive justice. Finally, triangulation and its enhancement of the credibility and validity of the data collected is explained.

3.3 RESEARCH DESIGN

The research design is the researcher's plan or methods aiming at providing an accurate description of the situation and the identification of relationships between critical variables. A research design is regarded as a process that has its beginning in the conceptualisation of the problem (145). Kothari, on the other hand, referred to research design as a conceptual structure within which research would be conducted (146) to gather maximum information that is valid and reliable. The mixed-method study design was adopted together with the Syndemic theory (3,130,147) and PHST

(17). This study employed qualitative, exploratory, descriptive, contextual, and quantitative, descriptive designs sequentially for Phases I, II, and III, while the novel surveillance framework was evaluated in Phase IV. Qualitative data was obtained through in-depth interviews with key informants which thereafter informed the development and use of a tailor-made quantitative data extraction tool for CVDs risk factors. This study has opted to assess (ex-post) the effectiveness of current data collection efforts in the PCBs and ePMS in terms of capturing, analysing, reporting, and using CVDs and its risk factors among PLHIV initiated on ART at targeted health facilities in the Khomas region. Furthermore, the Syndemic theory generation which was infused with other relevant theories such as PHST, and the Donabedian SPO model, Arthur's supervised learning model guided the development of the surveillance framework to facilitate the implementation thereof.

3.3.1 MIXED METHOD APPROACH

The study adopted a mixed-method approach in a pragmatic effort to analyse data management practices regarding routine tracking (data collection, data analysis, reporting, and data quality) of risk factors for cardiovascular diseases among PLHIV initiated on ART in the Khomas region. Mixed methods (MM) research is defined as an approach in which the researcher collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or program of inquiry (72). The mixed methodologies hold a pragmatic worldview whereby both narrative and numeric data and their analyses are used to contribute meaningfully to the finding of solutions to address a specific phenomenon. Drawing from the strengths of both qualitative and quantitative research approaches to compensate for the inherent weaknesses of each approach (66) is part of the main

reasons why the mixed methods approach was deemed worthwhile for this study. The use of the mixed-method approach brought together data, that was appropriate to inform the development of the surveillance framework for the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART. The following primary purposes of mixed methods suggested by Greene et al. (as cited in Gray, 2014) were also applied in this study (148):

- **Triangulation:** by combining both qualitative and quantitative methods, potential weaknesses, or confounding challenges of one method compensated for those that the researcher came across in the other process.
- **Complementarity:** overlapping outcomes and similar or different aspects of surveillance framework development were simultaneously measured and assessed.
- **Development:** the outcomes of the qualitative method informed the development of a tailor-made quantitative data extraction checklist and the identification of targeted data elements.
- **Initiation:** combines methods to allow for convergence of data and uncover quantifiable new insight that led to the reframing of the research question.
- **Expansion:** qualitative interviews explored the perspectives whilst quantitative data extraction focused on the outcomes followed by the development of the surveillance framework.

Based on these premises and in search of ‘truth’ and ‘reality’ from the pragmatism perspective, both qualitative and quantitative data collection and analysis were considered in this study.

An interview guide was developed to conduct in-depth interviews with key informants involved in ART data management processes. This process garnered data on the perception of health care workers on data management practices of routine tracking (data collection, data analysis, reporting, and data quality) of cardiovascular diseases among PLHIV initiated on ART. Data for this study were collected sequentially and analysed separately. The outcome of in-depth interviews informed the development of a quantitative data extraction checklist to assess risk factors associated with CVDs among PLHIV initiated on ART and described the availability and accuracy of CVDs risk factor data in the patient care booklets (PCBs) as well as the electronic patient monitoring system (ePMS). Thereafter, data was interpreted, triangulated, and conclusions were drawn from the findings which guided the development of the conceptual and subsequently the surveillance framework to facilitate its implementation.

3.3.2 QUALITATIVE DESIGN

Qualitative research produces descriptive data as one approaches the empirical world (65), and provides an understanding of people from their frames of reference and experience of reality (149). The espoused qualitative design helped the researcher, who was the key data collection instrument (150), to get a better understanding of what exactly was happening in terms of routine tracking and practices (data collection, data analysis, reporting, and data quality) of cardiovascular diseases risk factors among PLHIV initiated on ART. It is generally accepted that qualitative research is better posited to provide rich insights into the human experience, perceptions, motivations, and behaviours (151,152).

Although the researcher was well conversant with the data management processes at the targeted facilities, the perspectives and views of the respondents could not be taken for granted, as suggested by Chew-Graham (153). To answer the following research questions, a qualitative research approach was utilised through in-depth interviews with key informants:

- What are data management activities currently implemented, which are useful for providing integrated services to PLHIV to improve screening for CVD and its risk factors?
- How are CVDs and its risk factor data used for decision making and improvement of health services provided to PLHIV at health facilities?
- What are health workers' opinions on the possibility of developing a user-friendly surveillance framework to measure CVDs risk factors as well as predicting and managing health outcomes among clients enrolled in the ART program?

3.3.3 EXPLORATORY SEQUENTIAL DESIGN

For this study, the exploratory sequential design was applied. In an exploratory study, the researcher seeks to explore what is happening and to ask questions about the occurrence (145,148,154). By using this research design, the researcher gained insight into current practices of CVDs risk factor data collection, and subsequent interventions for PLHIV initiated on ART. Priority is usually given to the first phase (qualitative) in sequential exploratory strategies, after which the other phases are 'integrated during the interpretation phase' (63).

Additionally, this design makes the integration of qualitative and quantitative findings, testing of emergent theories, and generalisation of outcomes in a user-friendly manner.

For example, in this study, the exploratory approach gave the researcher pertinent information on routine data management practices and assisted with the development and better measurement (63) of the tailor-made data extraction checklist. A diagram that illustrates the exploratory design is shown in Figure 3.1. The diagram below illustrates the exploratory sequential mixed methods designs.

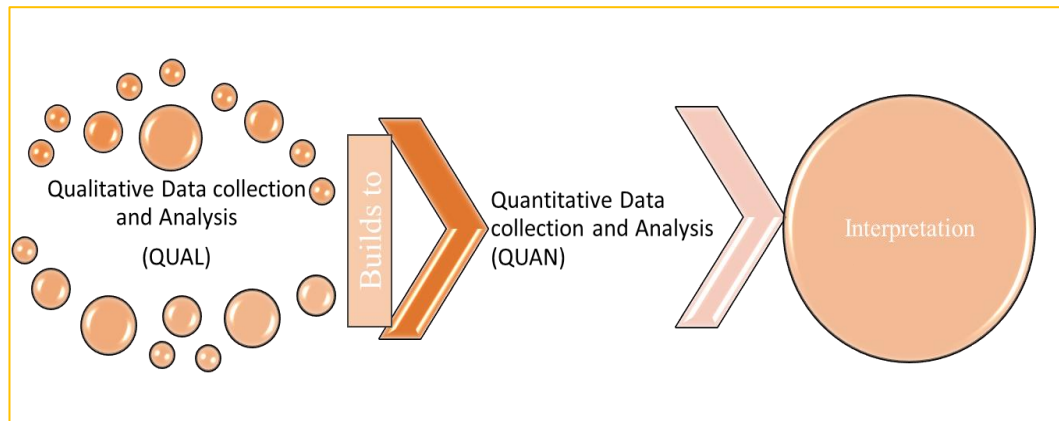


Figure 3.1: The research design: exploratory, sequential mixed methods (65)

3.3.4 QUANTITATIVE DESIGN

A quantitative research design that is generally confirmatory and deductive in nature is a formal, objective, systematic process in which numerical data are used to ‘determine cause-and-effect interactions between variables (145). According to Creswell, data is collected, quantified, and subjected to statistical treatment that will support or refute a particular phenomenon (63). Thus, the quantitative design was used to describe and test the relationships between hypertension and age, gender, obesity, smoking, alcohol history, and data quality elements such as availability and accuracy. In this study, the researcher assessed risk factors associated with CVDs among PLHIV initiated on ART and described the availability and accuracy of CVDs risk factor data in the patient care booklets (PCBs) as well as the electronic patient monitoring system (ePMS). Quantitative findings are presented in Chapter 4 in numeric forms of tables and graphs.

3.3.5 DESCRIPTIVE CROSS-SECTIONAL DESIGN

For a descriptive cross-sectional research approach to be practical, it should be preceded by exploratory designs (63). Descriptive studies generally describe a specific phenomenon as it occurs in its natural context (155); exploring attributes (72); or possibilities of relationships between variables (72). On the other hand, a cross-sectional study is viewed as a snapshot of a particular group of people at a given point in time (63). A single cross-sectional design was chosen because the study was conducted in the present time in a single round of current data collection efforts to examine during a specific time (146,156,157). Descriptive cross-sectional studies allowed the researcher to describe current practices of routine tracking of CVDs risk factors data collection, analysis of individual-level data, reporting, and use among PLHIV initiated on ART in a single study (145,148). The associations between variables were established, adjusted, and confirmed with a $p < 0.001$ to determine if exposure to specific CVDs risk factors might be correlated with health outcomes for PLHIV initiated on ART. These variations are presented in the findings in Chapter 4.

3.3.6 CONTEXTUAL DESIGN

According to Creswell, a contextual design provides a clear description of the context in which the research is taking place (145). The researcher also opted for a contextual design because action-related stories were better clarified in a particular situation or context. The study was conducted in the context of the Ministry of Health and Social Services at targeted health facilities offering ART services to PLHIV and offices of other selected key informants. This was necessitated to ensure that participants are at ease and comfortable to respond to questions within the safe boundaries of their

workplace culture. Furthermore, the contextual design permitted the researcher to contextualise and consolidate the responses of the key informants about the various data management practices in the Khomas region only. The background of the study and the setting in which it was conducted is explained in detail in chapter 1.

The study was conducted in the following phases, as depicted in figure 3.2 below:

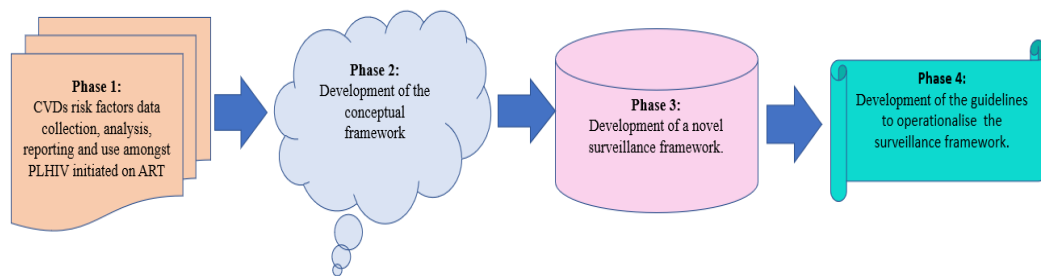


Figure 3.2: The process of developing the framework.

3.4 SCIENTIFIC REASONING STRATEGIES

Critical thinking during the application of reasoning strategies enabled the researcher to use knowledge and experience to identify related concepts, gain an understanding of variables and assumptions by responding to specific questions in an unambiguous manner. The reasoning strategies that guided the researcher to arrive at logical assumptions were inductive and deductive reasoning, inferences, bracketing and reflectivity, synthesis, derivation, and analysis.

Inductive reasoning was used to inquire about known facts of a shared understanding of CVDs risk factor data collection, collation, analysis reporting and use for PLHIV initiated on ART. Inductive reasoning was employed when the researcher started with the review of known literature that was subsequently complemented with the responses from the key informants during the data collection process in Phase 1. The perceptions of healthcare workers were explored and described. This led to the

generation of themes and sub-themes. The conceptual framework, as well as a surveillance framework in Phase 2 and 3, were developed subsequently.

Deductive reasoning is mostly used in quantitative approaches. This allowed the researcher to move from the ‘general premise to particular conclusions’ (154) by testing generated ideas in the real world. Through deductive reasoning, specific challenges about data management practices were identified. One of the significant findings of this study revealed fragmented data management practices for CVDs preventative care among PLHIV on ART which contributes to the inadequate measuring of health outcomes and thus reducing the quality of life of PLHIV initiated on ART. Deductive reasoning was used in Phase 1 by assessing risk factors associated with CVDs among PLHIV started on ART and to describe the availability and accuracy of CVDs risk factor data in the Khomas region. Notably, deductive reasoning guided the process of conceptualisation in Chapter 5, and the development of the surveillance framework that facilitates the implementation of the framework in Chapter 6.

Inferences refer to the ‘dynamic journey employed from ideas to data to results to make sense of the data by connecting the dots’ (66). The researcher simplified interpretations and draw conclusions from the data shared and collected from data managers on the availability of individual-level data, and the ability to uniquely identify and link CVDs risk factors to care provided to PLHIV initiated on ART. This process allowed for inference transferability, whereby generalisation and replicability to other regions could be advocated for in the future, based on the study findings. Secondly, these inferences also informed the development of the framework and

ultimately, recommendations for enhancing the tracking of CVDs risk factors among PLHV initiated on ART.

Bracketing in this study was maintained by employing scientific methods in collecting and analysing both qualitative and quantitative data. In this study, the bracketing process occurred during data collection, analysis, and interpretation of the findings. Furthermore, the researcher remained neutral and defused pre-conceived ideas even though the researcher was familiar with generic data management practices at primary health facilities in Namibia. Responses were solicited from health data managers by using probing questions as opposed to structured questions during the key informant interviews. The researcher's meta-theoretical and methodological assumptions were clarified in chapter 1 and 2.

Reflectivity was maintained by reflecting on discussions conducted with the health data managers focussing on their knowledge, day-to-day activities, and experiences, as well as their encounters with PLHIV initiated on ART at the respective health facilities. These introspections or reflecting exercises were consciously directed towards the existing theory and assumptions of the study. In addition, health care workers could go through these reflections on existing practices of routine data collection, analysis, reporting, and use for program decision making, emphasised weaknesses and areas that required strengthening in the continuum of care for PLHIV initiated on ART. Reflectivity was also made possible by connecting the different ideas gathered during the data collection process, validate these ideas or data elements and either refute or confirm the information.

Analysis: is described as a process that aims at interrogating and clarifying existing concepts and statements (72). Analysis conducted during the study employed a sequential design. Both the qualitative and quantitative analyses were conducted during the literature control and statistical analysis phase. Qualitative data were analysed qualitatively (inductively) whilst quantitative data were analysed quantitatively (deductively) in Phase 1. Analysis in this study helped to break down intricate data pieces into understandable categories which led to the identification of various concepts, its definitions, and an intervening statement that informed the conceptualisation process of the study and subsequently the development of the surveillance framework that facilitates the implementation of the framework.

Derivation: Derivation was applied in this study through the reviewing of the existing literature on surveillance of CVDs risk factors and PLHIV initiated on ART; results obtained from data analysis of in-depth interviews and secondary data of CVDs risk factors garnered from patient care booklets at the targeted health facilities in the Khomas region. Furthermore, components of the Syndemic theory, Population Health Surveillance Theory (PHST), Donabedian SPO theory, and several other related theories and models assisted with the formulation of interrelated concepts and central statements. These concepts were contextualised and later served as a foundation for the development of the conceptual framework which subsequently informed the surveillance framework for tracking and predicting health outcomes of the risk of CVDs among PLHIV initiated on ART to facilitate the implementation of the framework.

Synthesis: is generally described as the process of transitioning practice and knowledge about a phenomenon of interest into an integrated whole. This knowledge is merged from the clustering of interrelating ideas and concepts derived from the reviewed literature, and qualitative as well as quantitative data (158). The synthesis also helped the researcher to provide a blended understanding of what is known and not known in the study area through the interpretation of the study findings. In this study, current practices of routine tracking of health outcomes of CVDs risk factors data collection, analysis, and reporting and use among PLHIV initiated on ART were explored and described. The concepts and intervening statements were explained, and relationship statements were constructed. These outcomes served as the basis of developing a conceptual framework and subsequently, the surveillance framework to facilitate its implementation.

3.5 RESEARCH METHODOLOGY

Generally, the research methodology gives a systematic explanation and description of the procedures used by the research to unravel and respond to the research problem.

The methodology is discussed according to the four phases below:

Phase I: the situational analysis focussed on gaining an understanding of current data management practices at targeted health facilities.

Phase II: focussed on conceptualising and the development of a conceptual framework.

Phase III: summarises the process of developing the novel surveillance framework as described in chapter 6.

Phase IV: the process of developing guidelines to operationalise the novel surveillance framework for implementing the framework is discussed in detail in chapter 7.

All four phases played a significant role in responding to the ultimate purpose of the study which was to develop and describe a novel surveillance framework to track and predict health outcomes of cardiovascular disease risks among PLHIV initiated on ART in the Khomas region.

3.5.1 PHASE I: SITUATIONAL ANALYSIS

In this study, the situational analysis focussed on gaining an understanding of current data management practices of CVDs risk factor data collection, analysis, reporting, and use among PLHIV initiated on ART at targeted health facilities in the Khomas region. This phase adopted a mixed-methods design which was exploratory and descriptive in nature, and comprised objectives 1, 2, and 3. The first specific objective focused on exploring and describing health workers' perception of the data management practices, whilst the second objective assessed the risk factors for CVDs and the third objective described patterns of availability and completeness of CVDs risk factors' data among PLHIV initiated on ART. The methodology applied to each of these objectives is discussed below.

3.5.1.1 Specific objective 1(a): To explore and describe health workers' perception of data management practices of risk factors for cardiovascular diseases among PLHIV initiated on ART (qualitative).

To achieve this, the design, study population, sample and sampling method, data collection, trustworthiness, and data analysis are described as follows:

- **Design**

The qualitative approach using a phenomenological study design was chosen to inform the data collection of the study.

- **Study population**

The study population is usually referred to as the group of members or units of study that share similar characteristics based on their homogeneity or heterogeneity from which the researcher can confidently draw samples and subsequently conclusions in response to the overall purpose of the research. In the case of this study, the population were NIMART nurses, medical doctors, and data managers responsible for enrolling and initiating clients into the ART programme and those managing similar data in the Khomas region.

- **Sample and sampling**

The participants were purposefully sampled to the inclusion criteria; namely, healthcare workers delegated to work at Primary Health Clinics where clients are enrolled in and initiated into the ART programme as well as those providing technical oversight on HIV and CVDs data. Purposive sampling, which is a non-probability sampling technique, is widely used in qualitative research for the identification and selection of information-rich cases which allows for the generalisability of your findings (152).

According to Green and Thorogood, the sample size for a qualitative research study depends on the rationale of the study, the credibility of users, and the level of saturation (159). Congestion occurs when all possible responses are exhausted, and no new information is gathered from the research respondents (72). In order to collect extensive detail about each targeted health facility, no predetermined sample size was

proposed because data were collected until saturation occurred. Proponents of qualitative research studies indicate that 12-15 participants are sufficient to reach the level of saturation. Furthermore, this is confirmed by Rowley’s (2012) good rule-of-thumb, which states that one should aim for around twelve (12) interviews of approximately 30 minutes in length. As such, the researcher facilitated in-depth interviews with thirteen (13) participants comprising of nine (9) nurses, two (2) medical doctors, and two (2) data entry clerks as shown in table 3.1 below.

Table 3.1: Public health facilities and the number of participants interviewed at each facility.

Name of health facility	Number of health workers interviewed			
	Nurses	Doctors	Data Entry Clerks	Total
Groot Aub clinic	2			2
Katutura health centre	1		1	1
Khomasdal health centre	1	1	1	3
Katutura ART clinic (hospital)	1			2
Robert Mugabe clinic	1			1
Okuryangava clinic	1			1
Khomas District Office (PHC supervisor)	1			1
NGO_AI		1		
National NCD office	1			1
Total	9	2	2	13

- **Data collection method and procedure**

The instrument for data collection and the process is explained below:

- **The instrument for data collection**

An interview guide, consisting of one (1) main open-ended questions were used to generate qualitative findings(63).

- What are the perceptions of health workers of the current data management practices useful for providing integrated CVD-related preventive care services to PLHIV?

This question was supplemented with related probing questions such as describe the data management activities you have been involved with? If yes, were these data management activities useful for providing integrated services to PLHIV; if no explain why he/she was not involved. Do you currently collect data to improve screening for CVD risk factors and improve practices for CVD-related preventive care services among clients enrolled for ART? If Yes, how do you manage the data? Where do you enter the data? What do you do with the data after collection? Mention at least three risk factors that are currently monitored. Can you describe how you monitor these risk factors? If No: Are there specific reasons why screening for CVD risk factors is not taking place? Do you use the data captured for decision making and/or improvement of health services provided to PLHIV at your facility? If yes/no: understanding the reasons for using/not using health information for decision making. How are the prioritisation and use of CVDs related information among PLHIV related information in decision making is supported in terms of strategies, guidelines, and policies? What is your opinion on the possibility of developing user-friendly integrated surveillance framework to measure and manage CVDs risk factors among clients enrolled in the ART program? What do you think would need to be done to address any issues identified adequately?

- **Procedure for data collection**

Field preparation and Interview process

An in-depth interview process was followed to collect data for this objective. These interviews usually explore an issue or topic in depth whilst allowing respondents to talk freely around the specific matter under discussion says Gray (148). Although several authors believe that in-depth interviews are hard to analyse, the researcher found this method appropriate for collecting data for an exploratory and descriptive study (70,152,160) from the key informants.

Once permission for the study was granted by the Executive Director of the Ministry of Health and Social Services, Regional health directorate for Khomas, and the Chief Medical Superintendent of the Katutura State Hospital, appointments were made with respective sampled staff members. Gray encouraged building a rapport with respondents ought to be done especially when qualitative data is collected (148). This helps to establish respect and trust between the interviewer and respondent. Before the actual interview, informed consent was obtained, and permission was requested to record interviews. The researcher conducted all the interviews herself to make inferences from non-verbal reactions as well. All respondents were conversant with English; therefore, no translation of questions or language translators were used. In this instance, each interview lasted between thirty (30) minutes to one (1) hour.

Setting for the interviews

Interviews were conducted at the targeted clinics where PLHIV were screened, enrolled, counselled, and treated for various ailments while returning for follow-up ART. Health workers or data managers were interviewed at their respective duty

stations, which in most instances, were empty consulting rooms or the HIS offices at some clinics. Since the research was conducted in public health facilities, the researcher scheduled most appointments for interviews in the morning from 10h00 or in the afternoon after patient consultation had taken place. This was done to avoid disruption in the daily routine of the clinic staff.

Field notes and recording during interviews.

The researcher ensured that both verbal and non-verbal responses were captured accurately to provide appropriate feedback and rich data. Thus, supporting notes were taken by the researcher during the interview sessions to further assist with the analysis of the recorded data. At least 80% of the interviews were digitally recorded with permission granted by the interviewees. The remainder of the respondents who were unwilling to be recorded also agreed to sign the informed consent form.

○ **Trustworthiness**

Trustworthiness was ensured by applying the criteria of credibility, triangulation, transferability, dependability, confirmability, and peer debriefing (70,152) which are discussed in detail below:

- **Credibility:** was assured through **repetitive checks** of the researchers' interpretations and comparing the same with the data of those being interviewed (148). The researcher also reflected on the research by taking field notes, which cemented audio recordings and minimises possible biases. The researcher presented the study findings at research seminars, and corrections and modifications were made based on the recommendations by experts in research. One peer-reviewed article was accepted for publication. As part of assuring **external validity**, purposive sampling methods were used to

carefully select key informants whose responses allowed for naturalistic generalisations across various health districts.

- Data **Triangulation** was maintained by collecting data from multiple sites such as different health facilities in the Khomas region through **space triangulation**.
- **Transferability:** pertinent issues and factors with supporting direct quotes from the interviews were compared in context for similarity and judgments were made between similar cases (148). Similarly, a description of the demographics of participants and as well as describing the study findings also enhanced transferability. Continuous audit trails by the researcher and an in-depth explanation of the steps followed in the study, supported by literature review ensured **dependability** whilst **confirmability** showcased the connections between the data and the researcher's interpretations of the study (148). **Objectivity** was enhanced by receiving concurrence from the project supervisors by reviewing the various quotes and themes after the interview process.
- **Peer debriefing** was done through dialoguing with an experienced researcher (72) to avoid possible bias in interpreting qualitative data.

Other factors such as **consistency, accuracy, and neutrality** were maintained by checking with the interviewees that their responses were not misinterpreted during the interview process (148). Responses were reiterated and affirmed by interviewees. Confounding factors were accounted for by being objective, not allowing pre-conceived ideas to influence the thinking patterns. Verbatim transcriptions and direct quotations were used to ensure a true reflection of the

health care workers' perception of the data management practices at the targeted health facilities.

○ **Data analysis**

The researcher followed an inductive approach using ATLAS.ti software version 8.1 to organise text by relevant themes depict graphic and visual data, along with related links and memos (63). In addition to thematic analysis, summative content analysis was included to deduce meaning by coding and counting rich text data and making comparisons from the key informant responses. Accuracy of the findings was ensured by asking relevant questions and through continuous cross-checking at the data collection point and during content analysis. Additionally, an 80% consistency was maintained by documenting all the processes followed across the research project. Leedy and Ormrod (2010) as cited in Walliman (2011) assert that content analysis ought to be done in a systematic manner 'to identify patterns, trends, themes or biases' (p. 144)(68). Therefore, qualitative data obtained from in-depth interviews were transcribed, summarised verbatim, coded, and categorised into themes or patterns and reported using ATLAS.ti, a qualitative data analysis, and research software (63). The process of qualitative data analysis is summarised and outlined by Creswell (63), as follows:

- Preparing and organising data whereby voice-recorded interviews, as well as the narrative notes, were cleaned and organised by the researcher. Data were transcribed verbatim to ensure that the views and opinions of interviewees were accurately reflected. Several levels of quality assurance processes were followed by the researcher such as reading and re-reading transcribed data while simultaneously verifying it against the voice recordings.

- Reducing data after thorough interrogation was done by the researcher who randomly selected one interview script for proofreading and identification of probable higher-level themes. After that, the researcher exported the data from in-depth interviews to ATLAS.ti version 8.1.
- The open coding and coding in vivo functions were used by the researcher to generate the coding list based on the created categories. Coding the data by bracketing chunks was done in ATLAS.ti version 8.1.
- The code manager and the links function were used to compare the various responses by the participants, highlighting similar patterns and themes.
- Matching themes with the description of codes were purposely developed through the building of networks referred to code-quotations links and lastly,
- Themes and descriptions with similar meanings were interpreted by the researcher after they were exported to a scientific software folder. Reports were subsequently generated and are discussed in chapter 4.

3.5.1.2 Specific objective 1(b): assess the risk factors associated with CVDs among PLHIV initiated on ART (quantitative).

To determine the presence or absence of CVDs risk factors among PLHIV initiated on ART in Khomas region, the design, study population, sample and sampling method, data collection, and data analysis are described below:

○ Design

This quantitative cross-sectional descriptive study was adopted to extract commonly found risk factors for CVDs from the PCBs and ePMS of PLHIV initiated on ART.

- **Study Area**

Robert Mugabe, Otjomuise, Maxuilili, Donkerhoek, Groot Aub, Hakahana, and Wanaheda health facilities were selected as the study area. After the qualitative data collection process, secondary data on CVDs risk factors were extracted from the patient care booklets for people who had tested positive for HIV and initiated onto ART between 2004 and 2017.

- **Inclusion and exclusion criteria**

Polit and Beck (2012) describe inclusion criteria as the characteristics that qualify the study participants for inclusion in the study whilst the exclusion criteria, refers to those characteristics that eliminate a person from participating in the study (151,152). Several factors, such as the availability of the electronic patient monitoring system (ePMS) and the custodians of data at peripheral levels, influenced a site's likelihood of being selected for the study. The researcher only considered those patients who were initiated on ART at the time of data extraction. Equally, the clients enrolled in the programme before January 2004 and after 2017 were excluded from the study. The data collection and analysis efforts for the ART programme was institutionalised in 2004 hence the inclusion of such cases. Furthermore, the piloting of the new Quantum database in the Khomas region in 2018 necessitated the exclusion of those patients registered, enrolled, and initiated after 2017. As a result of these many exclusion criteria, the sample size of 876 was affected and reduced to 529 patient records which were included in the study.

- **Sample, sampling frame, and sampling method**

Sampling is defined by Stockemer (2019) as a process of selecting a number of participants from a larger group, to gain information on the entire study population, by the researcher (162). For the data extraction, the sampling frame consisted of all

those patients who were initiated on ART which were obtained from the targeted clinics. The researcher was guided by the clinic specific sample size to generate a list to extract randomly selected unique ART codes in SPSS. Thus, the simple random sampling methods were applied at the individual clinic level by using the clinic specific sampling frame which was informed by the specific clinic sample size factor. Unique patient identification numbers were randomly selected from the existing ePMS for PLHIV initiated on ART.

The sample size for this objective, which focused on the assessment of risk factors for CVDs, was calculated using statistical software, namely Epi Info, Version 7.0, for cross-sectional studies to get the actual sample size for the number of records to be reviewed at the targeted health facilities.

The required sample size was randomly selected, that is, 876 patients at a 3% error. After the sample size was determined, the sample size was further broken down at the clinic level; each clinic's specific sample size was determined by Probability proportional to size (PPS). The sampling size method allowed for a fair representation of all the study areas, as well as the number of patients in ePMS that was considered for this study. A total of 529 (60.38%) records of those PLHIV initiated on ART were successfully matched with their unique identification numbers in the ePMS.

The sample size for the extraction of risk factors from patient records was determined as follows:

Table 3.2: Sample size determination by health facility

Nr	Name of clinic	Total ART Population	Probability proportional to size (fraction)	Percentage per clinic (PPS*100)	ART Sample Size
1	Robert Mugabe Clinic	3276	0.37521	38	247
2	Groot Aub clinic	376	0.04306	4	37
4	Otjomuise clinic	2002	0.22930	23	152
5	Hakahana clinic	853	0.09770	10	117
6	Nathaniel Maxuilili clinic	818	0.09369	9	109
7	Wanaheda clinic	643	0.07365	7	97
8	Donkerhoek clinic	763	0.08739	9	117
Total		8731			876

○ **Variable selection and justification**

The CVD-specific risk factors such as blood pressure, body mass index (BMI), tobacco and alcohol use, were extracted from the Patient Care Booklet (PCB) as proxy indicators and to determine the magnitude of the risks of CVDs among PLHIV initiated on ART. Socio-demographic and programme data such as age, sex, marital status, blood pressure, overweight/obesity were obtained from the electronic patient monitoring system (ePMS) as independent variables at targeted health facilities in the Khomas region.

The researcher deliberately planned to extract data for cholesterol and blood glucose as well, but these measures were excluded due to the lack of data which is readily available. The study established that cholesterol levels and haemogluco tests (HGT) are only done on request by the medical doctor on a case-by-case basis. However, from all the targeted sites visited only one HGT reading was recorded in the PCB. No cholesterol readings were recorded in the PCBs at all.

The case definition for hypertension is the only well-defined predictor for CVDs at ART clinics hence, the reason why hypertension was used as the predominant variable

to compare with other predictors and covariates. This is in line with a study conducted by Divala et al., which revealed that almost 26.6% of patients in HIV care are either diagnosed with hypertension and/or diabetes of which close to two-thirds are diagnosed with stage I hypertension. Hypertension is a commonly collected data element at health care facilities. Hence, the reason why hypertension was used as the predominant predictor of CVDs and CVDs as the outcome variable. The criteria for hypertension endorsed by the American College of Cardiology and American Heart Association (ACC/AHA) were used to classify hypertension as follows:

- Elevated blood pressure: Systolic BP (SBP) 120-129 mmHg or diastolic BP <80mmHg;
- Stage 1 high blood pressure: SBP 130 to 139 mmHg or DBP 80 to 89 mmHg
- Stage 2 high blood pressure: SBP \geq 140 mmHg or DBP \geq 90 mmHg (95).

In a South African study conducted by Hyle et al. (2019) on cardiovascular risk factors among ART-experienced people with HIV, a fourth option was added which is a hypertensive crisis (SBP \geq 180 mmHg or DBP \geq 110 mmHg)(128). However, the fourth option was not considered in this study. The researcher based the classification on accurate measurements and average of \geq 2 readings on \geq 2 on different occasions (95) as recorded in the PCB.

Notably, age was also considered as a significant predictor or detrimental factor of hypertension in the multivariable model by the researcher (128). The older one gets, the higher the risk of hypertension(163). Hence, it is expected that one's blood pressure should be monitored continuously for follow-up interventions. Additionally, sex was also found to be a significant variable associated with hypertension (22,36).

Variables like weight and height were extracted to determine the body mass index (BMI) and subsequently examine the impact of obesity among PLHIV. BMI of 25 or above to determine if the client is overweight and for a BMI of 30 or above the client was classified as obese. BMI, smoking, and alcohol usage could not be used as the only standalone measure of risk factors for CVDs. Thus, to determine whether the PLHIV have a proven risk of developing cardiovascular diseases, the researcher postulated it accordingly (164):

- Combination of overweight, smoking, alcohol use, and at least one elevated or stage 1 hypertension.
- Combination of obesity, smoking, alcohol use, and at least one elevated, stage 1 or stage 2 hypertension.
- At least one elevated, stage 1 or stage 2 hypertension.

During the in-depth interviews, all the above-mentioned variables were highlighted as critical vital signs that are captured after the screening of PLHIV initiated on ART. These variables were therefore included in the data extraction checklist to collect data for objective 1c which will be discussed below.

○ **Data collection instrument**

A tailor-made quantitative data extraction checklist was used to extract socio-demographic and common risk factors for CVDs data such as age (128), sex, marital status, blood pressure(163), weight, and height which denotes the body mass index (BMI), tobacco history and alcohol use from PCBs and ePMS for this objective (see annexure 4). The variables in the data extraction checklist were aligned to the research objectives, as well as the theories and models established in the literature review. The data extraction checklist was divided into 3 sections. The first section of the checklist captured demographic information such as unique identification, age, sex, marital

status, and name of health facility, which was extracted from the PCBs. The clients' name, residential address, contact details, and any other variable that had the potential of breaching confidentiality were not included in the checklist. The second section focussed on the type of CVDs risk factors that are captured and entered into the PCB and ePMS. The third section focussed on the CVDs risk factors that were captured in the PCBs and the level of availability and completeness of these variables are described in the next objective.

- **Procedure for data collection**

CVDs risk factor data review and the extraction thereof were facilitated by the researcher. To achieve outcomes for specific objective 1 (b), client records were reviewed for CVDs risk factor data recorded in the PCBs. A pooled cross-sectional quantitative data from the patient care booklets (PCBs) between 2004-2017 was therefore used for this analysis. Socio-demographic and risk factor data such as age, sex, marital status, blood pressure, weight, height overweight, smoking, and alcohol usage were extracted from the PCBs and entered into SPSS version 25. Secondly, these data elements were matched with the Antiretroviral Therapy Electronic Patient Monitoring System (ART ePMS) data set managed and owned by the Ministry of Health and Social Services which offers real-time reporting on patients receiving ART. Data in this system contains the cumulative number of patients initiated on ART care since 2004 and which is denoted as the sum of ART patients. Furthermore, the data set also contains variables that the researcher used to determine the outcomes of ART, such as those lost to follow-up, died, active (alive), and hospitalised. The researcher found it appropriate to match the extracted data elements with what was captured by data entry clerks in the electronic Patient Monitoring System (ePMS). Statistical analyses were performed as described below.

- **Data analysis**

The extracted data were entered into IBM (R)Statistical Package for Social Sciences (SPSS) SPSS version 26 to perform statistical analyses. Once data were entered into SPSS for analysis, data cleaning was manually to ensure the quality of data extracted was not compromised.

Data were described using frequencies and proportions and summarised in tables and figures. Bivariate and multivariate analyses were performed by constructing two by two tables for each potential risk factor outcomes. Socio-demographic characteristics were tabulated by age, sex, and marital status. Findings were presented in the form of tables and graphs. The results of the study are presented and discussed in Chapter 4.

3.5.1.3 Specific objective 1 c: describe the patterns of availability and accuracy of risk factor data for cardiovascular diseases

Design

This study adopted a retrospective, cross-sectional, quantitative study design to determine health facilities' ability to collect and report quality data at the facility level and to identify gaps before developing the surveillance framework for tracking and predicting health outcomes of CVDs risks among PLHIV initiated on ART. This objective aimed at (i) determining the level of availability, and completeness of data related to CVDs and their associated risk factors and (ii) identifying strengths and gaps by reviewing health facility-based data obtained from individual patient care booklets at selected health facilities in the Khomas region. Lastly, the study (iii) made recommendations on corrective measures for strengthening the data management and reporting system and improving data quality.

- **Study Area**

An audit trail on data availability and completeness was performed at selected health facilities such as Robert Mugabe, Otjomuise, Maxuilili, Donkerhoek, Groot Aub, Hakahana, and Wanaheda clinics situated in the Khomas region.

○ **Sample and sampling methods**

The sample for objective 1c, which focused on the assessment of patterns of data availability and completeness, was purposely selected from the total number of health facilities in the Khomas region. As such, seven (7) out of the twelve (12) health facilities were selected for this exercise. These health facilities were Robert Mugabe, Otjomuise, Maxuilili, Donkerhoek, Groot Aub, Hakahana, and Wanaheda. Several factors such as the availability of the electronic patient monitoring system (ePMS) and the availability of the custodians of data at peripheral levels influenced a site's likelihood of being selected for the data quality exercise.

○ **The instrument for data collection**

Section 3 of the tailor-made quantitative data extraction checklist (as described under objective 1b), which focussed on the CVDs risk factors that were captured in the PCBs, the level of availability and completeness of these variables were developed based on the findings of the in-depth interviews which revealed that:

- Critical data elements such as blood pressure, weight, height, smoking, and alcohol history are captured in PCBs once PLHIV comes for screening at health facilities.
- The aforementioned data elements are available and recorded in ePMS.

A similar approach to data extraction tool development was followed by Xiao et al., who conducted a study on the influence of data quality assessments on data availability

and completeness in a voluntary medical male circumcision programme in Zimbabwe

(165). **Procedure for data collection**

The following process was followed to assess and improve the quality of the data captured:

- Individual patient care booklets and ePMS in which key CVD-related data is recorded at every follow-up visit were randomly selected to conduct a data trail.
- Data was thereafter extracted from PCBs and ePMS.
- Cumulative assessment of those clients who were transferred-out, lost to follow-up, or who have died quarterly was.
- Completeness was represented as the percentage of no missing data elements or blank spaces found in the patient care booklet which denoted the accuracy of these data elements.

Completeness of data is crucial to determine exposure emanating from CVDs risk factors among PLHIV initiated on ART; hence missing data was identified as the predominant variable in this objective to avoid misleading conclusions. The completeness score(165) was therefore developed to determine percentages of recordkeeping and missing data at each of the selected health facilities as shown below in table 3.3.

Table 3.3: Completeness Score

Indicator	Assessment criteria		Score
% Missing demographic and other systemic data	Demographics (Marital status, DOB, Age, St ART_Start_Year; Total Average of Follow-up Days; Total Average of visit per year)	1. At risk (inconsistent, incomplete, or missing demographic data (Marital status, DOB, Age) and other systemic data (Start ART Year; Total Average of Follow-up days; Total Average of visits per year)	25%
		2. Not at risk due to systemic challenges	75%

Although timely reporting has been identified as one of the significant successes of ePMS, incomplete data elements denoted data inaccuracy. Tracking and linking risk factors of CVDs to subsequent health interventions and outcomes of PLHIV initiated on ART were also considered by the researcher as one of the significant drawbacks of this system.

○ **Data analysis**

Similar to objective 1b, quantitative data extracted from the PCBs were entered in an electronic database and analysed using the Statistical Package for Services Solutions (SPSS) version 26 (see objective 1b, page 68). Descriptive statistics were used to categorise and describe continuous variables that were summarised using frequency distributions (bivariate or multivariate) and percentages for categorical variables and measures of central tendencies (mean, mode, distribution of maximum and minimum values for continuous variables). Findings were presented as tables and graphs.

3.5.1.4 Strategies for ensuring validity and reliability for objective 1b and 1c.

A tailor-made quantitative data extraction checklist was used to extract data from the PCBs and ePMS for the following CVDs risk factors: blood pressure, weight, height,

alcohol, and smoking history. Furthermore, data availability and completeness for variables such as marital status; date of birth, Age; start ART and start the year; a total average of follow-up days; and the overall average of visit per year). There was, therefore, no need to measure reliability and validity for secondary data.

3.5.2 MERGING QUALITATIVE AND QUANTITATIVE FINDINGS

In this mixed-method study, both qualitative and quantitative strands were conducted sequentially and then data sets were merged during a mixed-methods analysis phase. The process of qualitatively ascertaining themes is mainly advocated for when such variables are not streamlined, classified, or known (166). In the qualitative strand in-depth interviews were conducted to determine the perception of health care workers pertaining to data management practices of risk factors for CVDs among PLHIV initiated on ART, while in the quantitative strand, a tailor-made data extraction checklist was used. Thus, the researcher first reported the qualitative findings (themes and sub-themes) and thereafter presented the quantitative statistical findings that either confirmed or negated the statistical results (145). Both qualitative and quantitative data components were brought together at the results point of integration as well as at the analytical point of integration as postulated by Creswell (145).

Convergence was found between qualitative and quantitative strands. Through the qualitative narrative findings, the type of risk factor data captured during the screening of PLHIV initiated on ART was identified. However, the lack of harmonised CVDs risk factor data collection, analysis, reporting, and use for decision-making was revealed as a significant drawback of the current health system. These findings informed the process followed to extract and confirm the CVDs risk factor data from

PCBs and ePMS, their availability, and completeness. These findings are presented in chapter 4.

A narrative-contiguous approach was used to integrate and present the qualitative and quantitative findings of the study within a single report but in different sections. A similar procedure was followed by Fetters, Curry, and Creswell in their article on ‘*achieving integration in mixed methods designs*’(63) as well as Carr, who also published an article on ‘*exploring the effect of postoperative pain on patient outcomes following surgery*’ (166,167). The figure 3.3 illustrates the findings of objectives 1a, b, and c below.

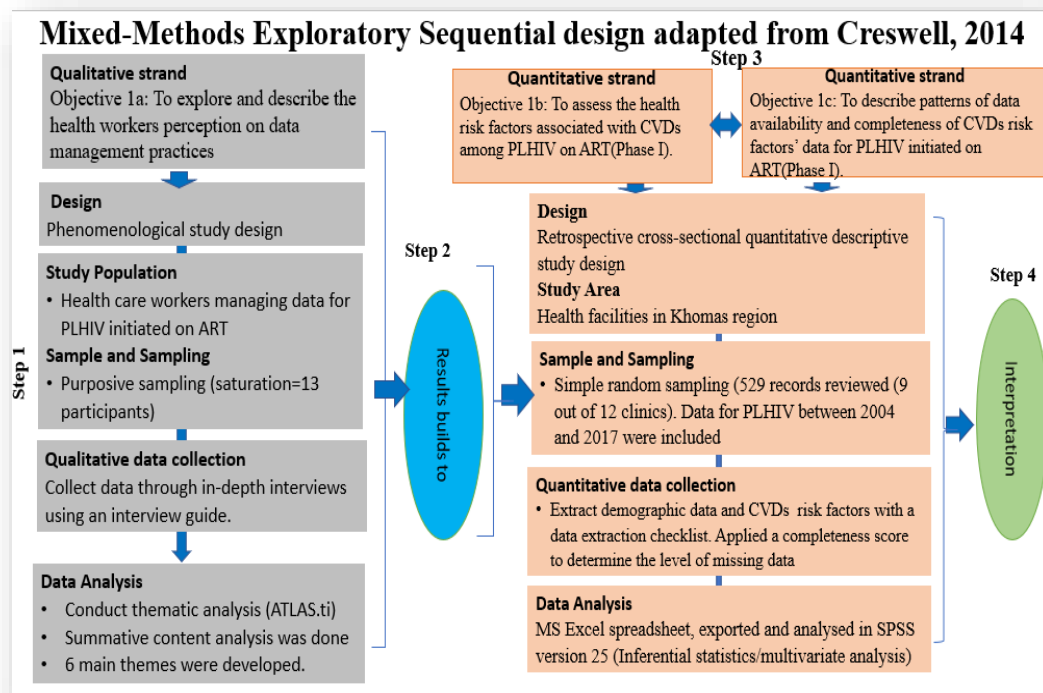


Figure 3.3: The merging of sequential explorative QUAL-QUAN findings from study objectives 1a, b, c (Mahalie, 2019)

3.5.3 PHASE II: CONCEPTUAL FRAMEWORK

Burns and Grove define a conceptual framework as “the abstract, logical structure of meaning that guides the development of the study and enables the researcher to link

the findings to the existing body of knowledge” (168). Phase two, which focussed on conceptualising and the development of a conceptual framework, responded to objective 2 as articulated below:

To develop a conceptual framework for tracking health outcomes of CVDs risk factors among PLHIV initiated on ART from the findings of the study.

This study modified and utilised Schwartz and Kim’s hybrid model of concept development which consist of the following three interconnected phases such as theoretical (literature and experience); field work (data collection) and final analysis for the process of conceptualisation (169,170).

The researcher adopted the multifaceted interactive reasoning of the Syndemic theory (124,130,147), Donabedian’s three elements which comprise of the structure, process, and outcomes (10,137,139) were fused into the six elements of El Allaki et al., (trigger, problem formulation, surveillance planning, surveillance implementation, and information generation and audit) (17) together with the findings from the study, to delineate the researcher’s reasoning map. The aforementioned theories guided the development of the conceptual framework.

Interrelated concepts such as **enabling environment**, **sound data management practices**, and **evidenced-based health outcomes** were identified. The ideas contributed to the development of the surveillance framework to track and predict health outcomes of cardiovascular disease risks among PLHIV initiated on ART in the Khomas region which was the purpose of the study. The conceptual framework is

discussed in detail in chapter 6. This synopsis is graphically demonstrated below in figure 3.4.

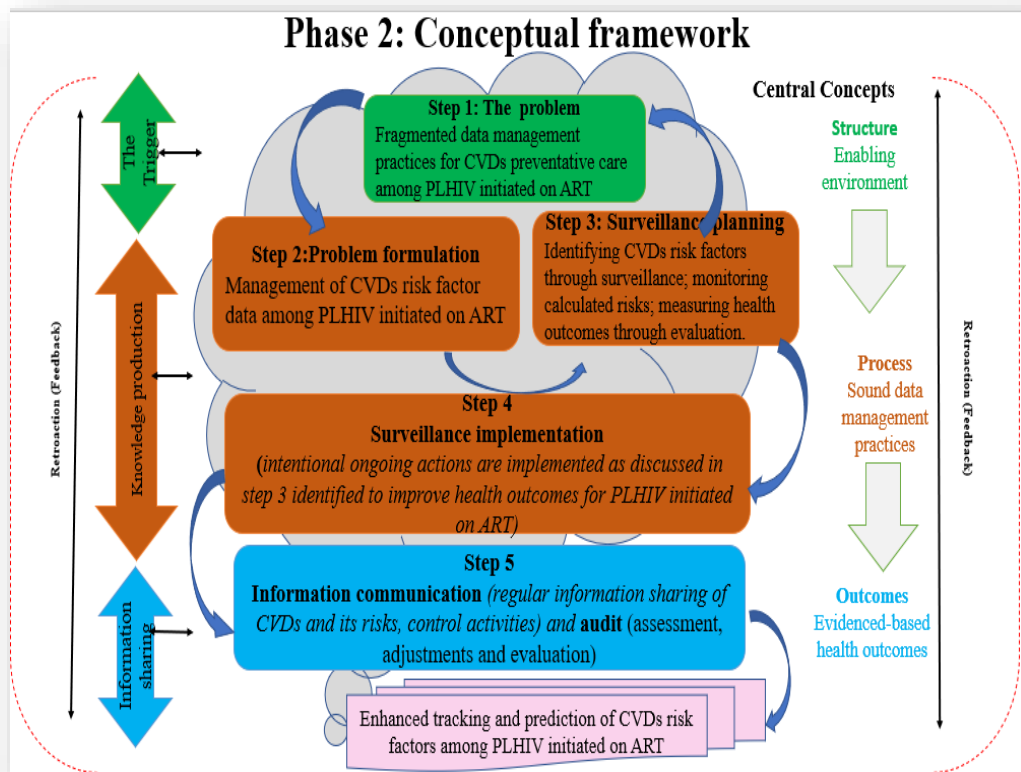


Figure 3.4: Conceptual framework for tracking of health outcomes of CVDs risk for PLHIV initiated on ART (Mahalie, 2019)

3.5.4 PHASE III: DEVELOPMENT AND DESCRIPTION OF THE NOVEL SURVEILLANCE FRAMEWORK

Phase III summarises the process of developing the novel surveillance framework, which is described in chapter 6. The surveillance framework for tracking and predicting health outcomes of CVDs risks among PLHIV initiated on ART was developed based on the study findings Phase I and the conceptual framework developed in Phase III. Objective 3 responded to this phase:

To develop and describe the novel surveillance framework to track and predict health outcomes of cardiovascular diseases risks among PLHIV initiated on ART in Khomas region.

The development process of the surveillance framework and its subsequent validation is briefly summarised below.

Development and description of the framework

The Syndemic theory, PHST model of El Allaki et al., (17), and Donabedian's SPO model (10) was adopted to develop the framework focussing on surveillance of risks for CVDs; monitoring calculated risks and evaluated measured CVDs outcomes among PLHIV initiated on ART. Arthur Samuel's machine learning model of 1959 (140) was used to enhance the prediction of CVDs risks. Ultimately, various strategies were used to facilitate the development of the framework that is meant to enhance the tracking and prediction of health outcomes of cardiovascular risks among PLHIV initiated on ART at health facilities in the Khomas region using the following sequence as depicted in figure 3.5 below.

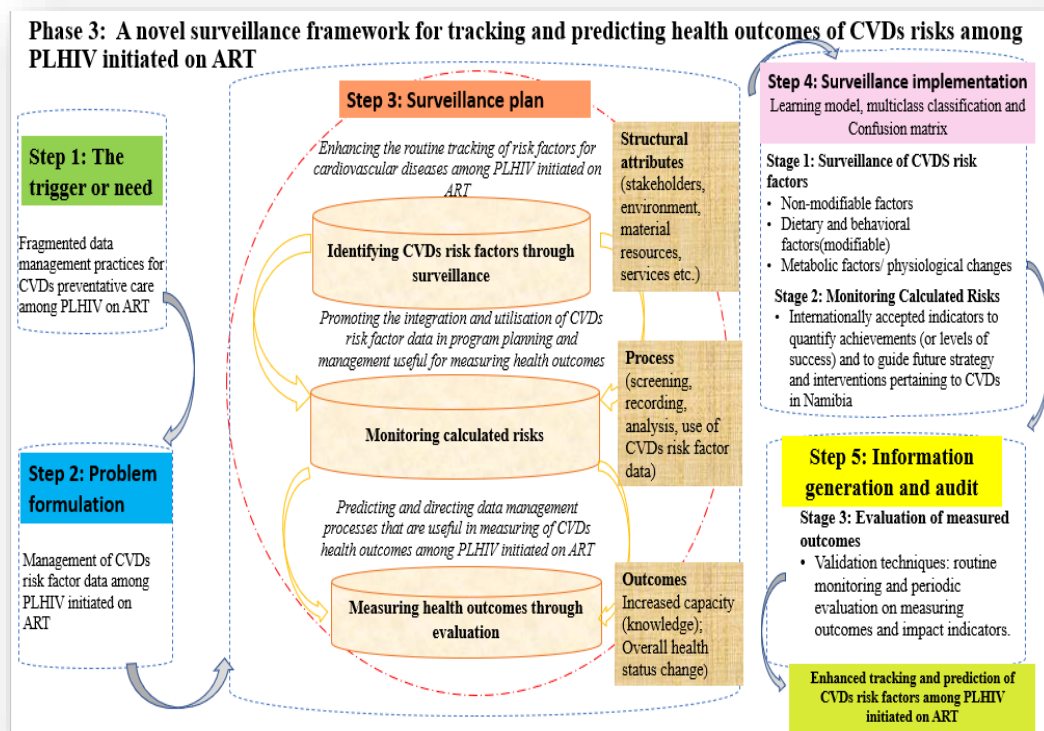


Figure 3.5: The proposed outline of the surveillance framework (Mahalie, 2019)

The development and description of the framework are presented in Chapter 6.

Evaluation of the framework

The surveillance framework was designed to be used primarily at the health facility and district levels of reporting. Admittedly, the national level population surveillance were beyond the objectives of this study. The framework was reviewed by using a set standard, well-researched, and accepted method of evaluation as proposed by Richey and Klein (171) through the following questions:

- To what extent does the framework address relevant environmental factors?

- Does the framework include all the necessary elements of sound data management practices (data collection, data collation, data analysis, reporting, and use)?
- To what extent is the framework usable in a wide range of settings?
- Is the use of the framework cost-effective?

The framework was therefore reviewed and validated by a group of experts who are:

- well vested in the arena of CVDs, PLHIV initiated on ART and theory generation.
- The development of M&E frameworks using machine learning to predict health outcomes.

3.5.5 PHASE IV: DEVELOP THE GUIDELINES TO OPERATIONALISE THE NOVEL SURVEILLANCE FRAMEWORK.

After the description and development of the novel surveillance framework, the process of developing the guidelines for implementing the aforementioned framework is discussed in Phase IV under objective 4:

To develop guidelines to operationalise the novel surveillance framework to facilitate the implementation (Phase IV).

The guidelines, to operationalise the framework, are presented as recommendations based on the three interrelated components of Samuel Arthur’s machine learning model, namely *identifying CVDs risk factors; monitoring calculated risks, and measuring health outcomes*. These core elements are intended to take place in an **enabling environment** which applied **sound data quality management practices** to ensure **evidenced-based health outcomes** for PLHIV initiated on ART.

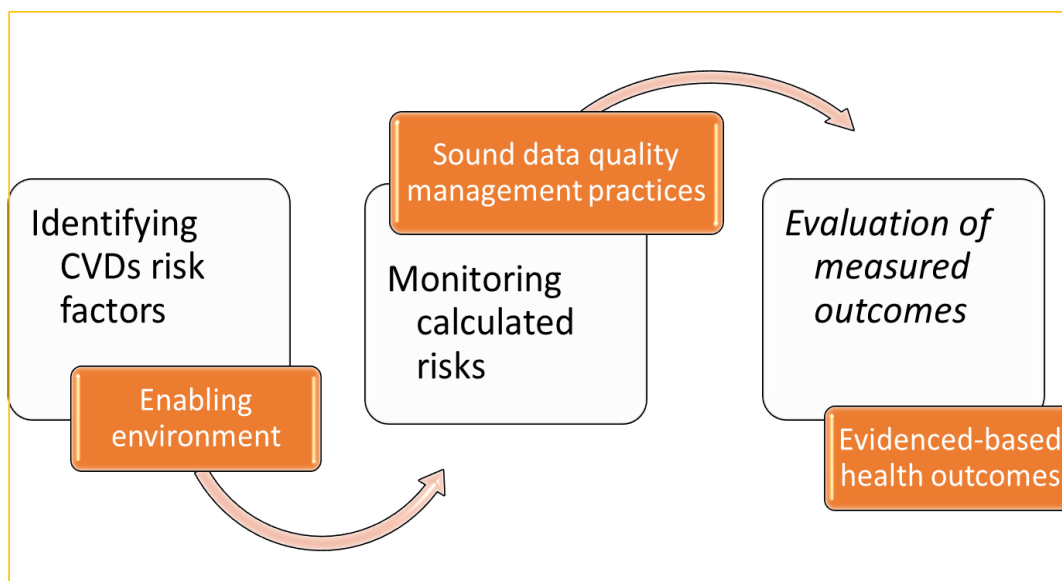


Figure 3.6: Samuel Arthur's modified machine learning model (Arthur, 2018; Mahalie, 2019)

The operational guidelines were developed which will facilitate the implementation of the framework, as discussed in chapter 7.

3.6 PILOT TESTING OF DATA COLLECTION INSTRUMENTS

Pilot testing was conducted to ensure the drawing of meaningful and useful interferences and to prevent possibilities in bias. Permission was granted to conduct the pilot study at Otjiwarongo Regional hospital by the Acting Regional Health Director of the Ojondjupa region to pilot test the research instruments with healthcare workers (3 nurses, 1 M&E officer, 2 Data Entry clerks, 1 pharmacist assistant, and 1 health assistant) and 3 PLHIV at the ART clinic. These respondents had similar characteristics to the actual study population. The structured questionnaire for health care workers, observation checklist, self-administered questionnaire for

PLHIV, and interview guide were tested before the commencement of the study. Appropriate changes and improvements were factored-in after this exercise, namely,

- appropriate changes were made to the interview guide following **in-depth** interviews with healthcare workers. Rhetorical questions that did not contribute directly to the study's objectives were rephrased and/or eliminated to reduce the duration of the interview to the minimum. The interview guide was reworded to make room for more probing during interview sessions.
- the observation **checklist** and the self-**administered** questionnaire with PLHIV were considered redundant as advised by the outcome of the pilot testing. Secondary data extraction from patient care booklets and ePMS were instead considered as the most appropriate way of measuring data quality management practices such as capturing and documenting CVDs and its risk factors among PLHIV initiated on ART. A data extraction checklist was developed to extract individual patient data on CVDs risk factors and to measure the availability and completeness of these data elements based on the outcome of the qualitative in-depth interview process.

3.7 ETHICAL CONSIDERATIONS

Ethics are a set of internationally recognised code of conduct, rules, and regulations that guide the facilitation of research with human beings. Homan (1991) explains ethics as the 'science of morality' (148). The following ethical values were considered during this study:

3.7.1 Permission

The researcher obtained **permission** to conduct the study from:

- The University of Namibia's Research and Ethics Committee (Annexure 1).

- The Ministry of Health and Social Services: Research and Ethics Committee (Annexure 2).
- Khomas Regional Health Directorate (Annexure 3).
- Katutura Hospital Chief Medical Superintendent (Annexure4).

3.7.2 Informed consent

Relevant information concerning the envisaged study was provided to all research participants and thereafter written and verbal/written informed consent were obtained once a full understanding of the purpose of the study was gained. The researcher explained the purpose of the research and subsequently the informed consent form was signed by the participants. The informed consent form indicated that participation was voluntary and that participants were free to withdraw at any time without any penalty being imposed on them (see annexure 5).

3.7.3 Respect for persons

All research participants were treated with respect and dignity as autonomous individuals. The well-being of all research participants remained the top priority of the researcher. The data collection processes were explained. Furthermore, **confidentiality** which is the process of keeping information obtained during the study in the strictest confidence, as well as anonymity (protecting the identity of the research subjects), were maintained as suggested by Teddlie and Tashakkori (66). Participants were requested to use their initials when signing the informed consent form; specific names were not linked to any individual responses obtained during in-depth interviews. The researcher opted to use pseudonyms where appropriate.

3.7.4 Beneficence

Participants were not exposed to any harmful practices or circumstances during the data collection process and afterward. Since this was a non-experimental study, no anticipated adverse effects were anticipated towards the participants. The benefits of the surveillance framework were explained to the research participants, which would be an added advantage to its users.

3.7.5 Distributive justice was applied to all research participants. Fairness was maintained by interviewing key informants such as health data managers who are involved in the actual data collection, collation, analysis, and use at the sampled health facilities.

Confidentiality, privacy, and anonymity were maintained by protecting the identity of the research participants throughout the study.

3.8 SUMMARY

This chapter described the mix-method approaches which employed both qualitative and quantitative research designs that utilised sequential exploratory and descriptive designs. The population, sampling, methodology, reasoning strategies, and ethical considerations were outlined. The researcher gained an understanding of current data management practices by using qualitative approaches such as in-depth interviews whilst findings from quantitative data sources such as data extraction checklist, and data quality audits were synthesised. The conceptual framework was only developed when the researcher had an understanding of the current data management processes of risk factors for CVDs through the process of conceptualisation. The inductive-deductive research cycle was used to move from grounded results to deductive inferences which resulted in the development of the surveillance framework. The data will be presented and discussed in the next chapter.

CHAPTER 4: PRESENTATION OF THE RESULTS AND DISCUSSION

4.1. INTRODUCTION

The first part of this chapter presents both qualitative and quantitative research findings and the second part discusses these findings. Furthermore, the results contained narrative and descriptive results for objective 1a which was to explore and describe the current practices of routine tracking of health conditions due to cardiovascular risk factors' data collection, analysis, and reporting and use among PLHIV initiated on ART. The quantitative findings were derived from two objectives, namely: to assess the health risk factors and to describe patterns of data availability and completeness of CVDs risk factors' data for PLHIV initiated on ART. These findings were critically analysed and discussed which guided the process of concept analysis, construction of the conceptual framework, and the development of the surveillance framework for tracking CVDs risk factors and predicting health outcomes among PLHIV initiated on ART in the Khomas region. Since the study was a qualitative-quantitative sequential mixed-method, triangulation of data was done by comparing both findings and conclusions drawn thereafter. Qualitative findings were reported first followed by the quantitative statistical results that either confirm or refute the narrative results.

4.2 PRESENTATION QUALITATIVE FINDINGS

The qualitative results about the *health workers' perception of data processing activities for delivering comprehensive CVDs-related preventive care services to PLHIV initiated on ART in the Khomas region* informed the construction of the quantitative data checklist and subsequent statistical data analyses. Qualitative data

were collected through in-depth interviews with key informants. The narrative results were transcribed verbatim, exported to ATLAS.ti, and analysed by generating themes, quotes, and networks. Networks, which are defined as a set of nodes and links, were used for the retrieval of conceptual information. This process helped the researcher to graphically depict and explore relationships between the connected nodes, which was drawn with an arrow (172). Direct quotes from the different respondents are presented in italics.

This section discusses the main findings emanating from the narrative results for objective 1a, which is the:

Exploration and description of health workers' perception of data processing activities for delivering comprehensive CVDs-related preventive care services to PLHIV initiated on ART in the Khomas region.

Table 4.1 below shows a summary of the degree of the respondents' views from the interviews on current practices of collection, analysis, reporting, and use of data for CVDs risk factors. The degree denotes the density or number of links between a node and the network (151,152). This is depicted according to the number of times related issues were mentioned under each theme. For example, under Theme 1: Monitoring exposure of CVDs risk factors among PLHIV, a total of 14 responses contributed to the generation of the theme. The themes and sub-themes are presented in Table 4.1 below.

Table 4.1: Main themes and sub-themes from data analysis (Mahalie, 2019)

Main themes	Sub-themes	Degree
Theme 1: Monitoring exposure of CVDs risk factors among PLHIV	Lack of concerted/fragmented surveillance and monitoring efforts to track and link CVDs risk factors collected to PLHIV for individual follow-up care	14
Theme 2: Measuring health outcomes of CVDs risk factors among PLHIV	Lack of consolidated data on CVDs risk factors and progress made in tackling them with tangible health outcomes.	19
Theme 3: Handling or Managing of risk factor data for CVDs (electronic and paper-based)	Inconsistent handling and managing of CVDs and its risk factors. Lack of standardised efforts and links between information provided on CVDS risk factors by health workers and subsequent health interventions.	26
Theme 4: Utilisation of CVD data for decision making	Lack of an integrated system that encourages regular, institutionalised feedback and use of CVDs and its risk factors for subsequent interventions among PLHIV initiated on ART. Insufficient feedback and usage of data to generate evidence-based information to reduce CVDs among PLHIV.	32
Theme 5: Health System response and capacity to manage CVDs among PLHIV	Inadequate data collections/parallel systems with no interoperability. Inadequate human and material resources	22
Theme 6: Existing guidelines, policies and strategies on the integration of clinical interventions of CVDs among PLHIV	Lack of standardised/institutionalised strategies, policies and guidelines to facilitate regular integrated CVDs risk factor surveillance and M&E among PLHIV initiated on ART. Lack of knowledge on the existence of the national strategy on NCDs.	18

4.2.1 Qualitative research findings of in-depth interviews

Although quality data management remains a priority for any health care service delivery, interviewees identified a range of issues hindering the success of effective monitoring and evaluation of risk factors for CVDs. The various themes that were developed, as indicated in the table above, will be discussed in detail below. Furthermore, challenges were identified, and recommendations were also proposed by health workers.

4.2.2 Presentation of demographic characteristics of key informants

The respondents were requested to provide information on gender/sex, job category, and years of experience before the actual interview session. The researcher purposely sampled key informants to participate in the study. There were thirteen (13) respondents comprising nine (9) nurses, two (2) medical doctors, and two (2) data entry clerks were interviewed. The majority of the respondents were females (62%) whilst the minority were males (38%). A total of 69% were registered nurses, whilst 15% were medical doctors and data, entry clerks. Most of the respondents had at least 5-10 years of working experience as a healthcare worker. This data was analysed by determining the frequencies and percentages of each item of data, as shown in Table 4.2 below.

Table 4.2: Characteristics of key informants

Characteristics	Number	Percentage
Sex		
Male	5	38
Female	8	62
Job Category		
Registered Nurse	9	69
Medical Doctor	2	15
Data Clerk/Admin Officer	2	15
Years of Experience as Healthcare Worker		
<5 Years	5	38
5-10 Years	6	46
>11 Years	2	15

Five prominent themes related to data management practices regarding CVDs and associated risk factors in the context of HIV at targeted health facilities were identified during the qualitative data analysis. These themes are presented below:

Theme 1: Monitoring exposure of CVDs risk factors among PLHIV

Monitoring of CVDs exposure is operationally defined as measures put in place at health facilities to identify the types of parameters or data on risk factors of CVDs are captured and recorded using appropriate data collection tools. In evaluating the constraints on monitoring exposure of CVDs and associated risk factors in the Khomas region, this research underscores the importance of monitoring each person initiated on the ART programme to ensure early screening, detection, and treatment against the potentially devastating effects of CVDs. The following sub-theme was identified:

Sub-theme 1.1 Lack of concerted surveillance and monitoring efforts to track CVDs risk factors to PLHIV for individual follow-up care.

The healthcare workers' understanding of the processes involved in CVDs risks factors data collection, reporting, and analysis; the frequency of data reporting, the kind of information obtained, functional health outcomes, and data dissemination were deliberated on. The study established that data collection efforts by health workers are appropriate for the examination of the prevalence of health risk factors for CVDs. The majority of the respondents agreed that routine screening which includes parameters such as blood pressure, pulse, respiration, saturation, height, weight status, smoking, and alcohol consumption is done on all clients enrolled in the ART programme. However, additional screening tests such as cholesterol and haemoglobin test (HGT) are only done at the doctor's request. Some of the respondents narrated data capturing for cholesterol and haemoglobin as follows:

“Cholesterol is only taken when a patient is complaining of heart-related problems” (P4)

“...fasting blood glucose is done to rule out any form of diabetes”. (P8)

Although most of the respondents indicated that smoking and alcohol history is routinely collected at their respective health facilities, some of the respondents had a different opinion as quoted below:

“Smoking and alcohol usage is not much emphasized unless there is a specific need like someone defaulting from chronic medicine because of alcohol”.(P3)

“Smoking and alcohol are not done often. We usually ask this question when the patient is initiated on ART”.(P2)

Figure 4.1 below summarizes the various quotes and networks generated under theme

1

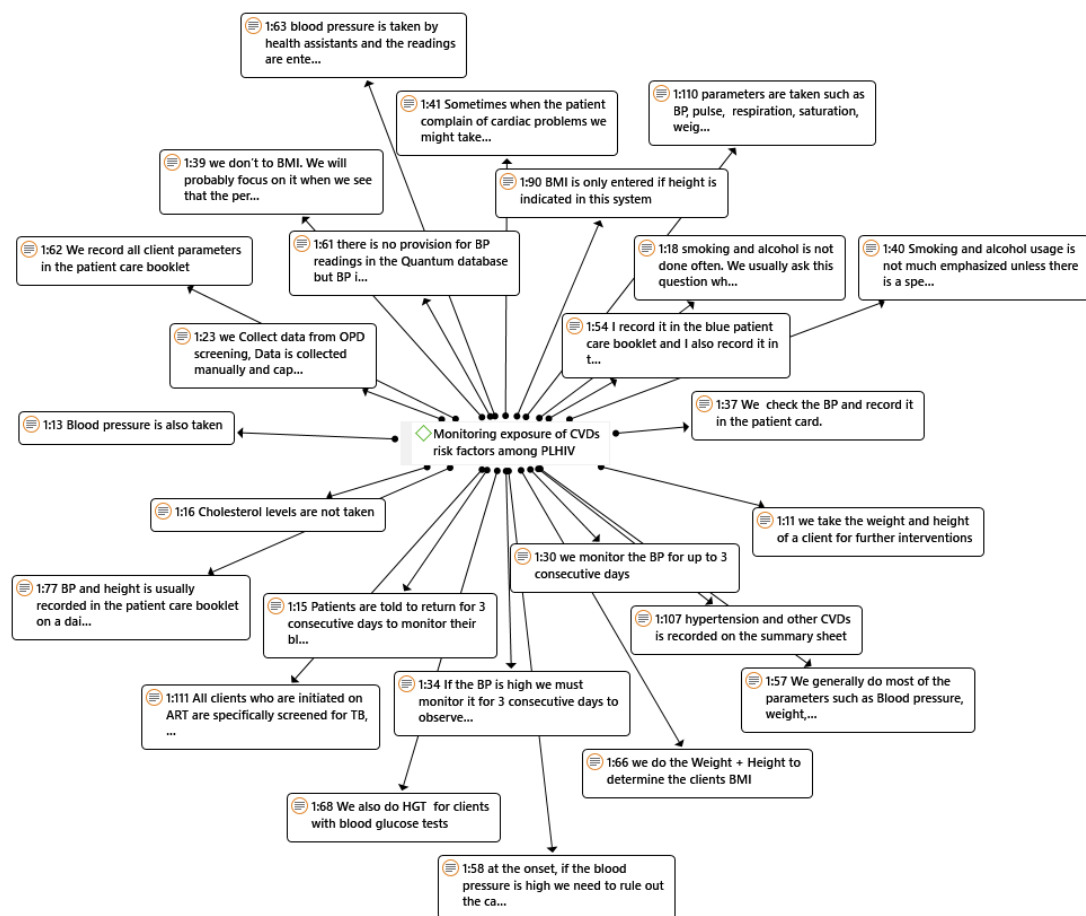


Figure 4.1: Monitoring exposure of CVDs risk factors (degree:14)

The second theme will be discussed in the next paragraph.

Theme 2: Measuring health outcomes of CVDs risk factors among PLHIV.

Measuring health outcomes is regarded as the process that is followed at the health facility to ensure that data captured for CVDs and associated risk factors address information needs which in turn will contribute to all-inclusive health interventions for PLHIV. Under this theme, the majority of the respondents agreed that there are no standardised ways of measuring health outcomes. Ideally, all parameters taken from PLHIV should be linked to subsequent health interventions for each client, which is not always the case. In sub-theme 2.1 some respondents shared their sentiments below:

Sub-theme 2. 1 Lack of consolidated data on CVDs risk factors and progress made in tackling them with tangible health outcomes.

Seven out of nine respondents have indicated that general parameters are collected manually and captured in the patient care booklet, health passports, and OPD tally sheets. However, the study revealed that although some data collected for CVDs risk factors is obtained and consolidated, it is not appropriately linked to subsequent health interventions for PLHIV. Some respondents indicated that all the parameters taken from the client are recorded in the patient care booklet (PCB) as elucidated below:

"The patient care booklet is used to inform and guides information that is needed in terms of patient care, and this information is afterward captured into the book and the system called ePMS". (P2)

"We take parameters from every client that visits our facility e.g. blood pressure is taken by health assistants, and the readings are entered into the patient care booklet".(P8)

“BP and height are usually recorded in the patient care booklet on a daily basis”.(P3)

“The data entry clerks pick up the patient care booklets and usually enter the data into the ePMS”. (P8)

However, all the respondents who are actively involved in patient care at an operational level have indicated that parameters such as BMI and those taken during follow-up visits are not entered into the electronic patient monitoring system (ePMS) at their respective health facilities. This is quoted below by two of the respondents:

“BMI data is not captured in a system. We record this data in a normal book”.(P2)

“Follow-up parameters are not entered into the database. It is recorded in the patient care booklet and passport”.(P9)

Although ePMS is used to record all relevant data regarding a client who is enrolled and initiated on ART, one interviewee indicated that the paper-based system is still being used at their facility as quoted below:

“Data is collected manually and captured inpatient health passports and OPD tally sheets, so we don’t have electronic systems at this clinic”.(P3)

Some healthcare workers also indicated that the current focus had been shifted to IPT, PrEP, and TB. This could be one of the factors hindering the effective integration of CVDs as one critically scrutinises the following statements below:

“In fact, the focus is not so much on risk factors for cardiovascular diseases.”(P11)

“The clinic is usually hectic, so the focus is on IPT, PReP, and TB for now.”(P3)

“Focus is currently on EPI and not so much on NCDs”.(P10)

It was also noted that Quality Improvement (QI) projects initiated by donor agencies had been shelved due to financial constraints. As a result, critical indicators for CVDs risk factors assessment are not a priority, as indicated by another respondent below:

"BP is excluded in NAMLIFE since we have reached our target, which is 100%, so that's why that data element is excluded."(P8)

The third theme on handling or managing CVD risk factor data is discussed next.

Theme 3: Inconsistent handling or managing of risk factor data for CVDs (electronic and paper-based)

In this theme processes which are followed to ensure that data collected for CVDs and its risk factors are captured authentically, stored without compromising its security, cleaned, analysed, interpreted systematically, reported to various levels, used for decision making and written feedback is provided regularly were highlighted. The following sub-themes were extracted from the central theme 3.

Sub-theme 3.1 Inconsistent handling and managing of CVDs and associated risk factors.

Although efforts are made to capture data for CVDs risk factors, the minimal focus is put on reporting, tracking, or linking of CVDs risk factors to PLHIV and subsequent interventions. Furthermore, as indicated in the previous theme, not all the data that is collected and captured on the paper-based system makes its way into ePMS. Findings from this study revealed that data entry clerks are mostly responsible for handling and safeguarding patient records and data. Admittedly, measurements of health outcomes for follow-up consultations are not done routinely, as explained below:

“once the client is screened in a consulting room, and the nurse cannot manage the condition the client is referred to the Dr, but mostly CVDs are not directly diagnosed by the nurses”.(P10)

“in most instances when a clients’ blood pressure is high we ask him/her to come for 3 consecutive days for BP check and proper monitoring”.(P11)

Generally, respondents agreed that data is compiled, and reports are submitted regularly, but they are not sure how information is handled or managed once it goes from the peripheral levels. This study found that written feedback received through the respective channels of communication is sporadic as cited below:

“I am not so sure what is currently happening with the QI reports and how the data is managed at DSP”.(P2)

“...summarized reports are compiled at the end of each month and send to the Directorate of Special Programs (DSP) through the clinical and nurse mentor”.(P2)

Respondents were also asked to elucidate on the provision of feedback from their respective channels of communication. It is a well-known fact that whatever reports containing health data that is forwarded should receive documented feedback. The researcher is of the opinion that bi-directional feedback establishes strong relationships between beneficiaries of the health services, data managers, and champions of strategic information at all levels of reporting. This study found that feedback on reports that are submitted is sporadic. Respondents had the following expressions:

"They usually give feedback on critical cases every month but not on every indicator on the statistics...like malaria, and now we are having hepatitis E".(P3)

"It depends, maybe once per year but if there is a challenge or if there is a problem with the report they will give feedback where we need to improve".(P4)

"No written feedback was provided for the other reports submitted in the past".(P4)

"We receive feedback...hmmm...mostly when there are challenges and at the regular DCC meeting". (P5)

'Feedback is usually given by DSP whenever we report a specific problem or sometimes during workshops. But to date, no written feedback on reports was given to us" (P9).

"No, I don't know of written feedback, but I think if there are issues they communicate via the internet". (P10)

According to one respondent, regular feedback is received from the clients visiting their health facility, as indicated below:

"there is a client's committee that provides constructive feedback in the suggestion boxes".(P2)

The majority of the respondents who are actively involved in the delivery of patient care at the operational level indicated that data is interrogated, and review sessions are sporadic, but the emphasis is not on CVDs and associated risk factors. On the contrary, to those who have review meetings at their respective facilities, some respondents reported not having those meetings at all. Others said that the focus of their meetings is not on CVDs and risk factors. This is evident from the following statement:

"...but we don't have data review meetings where we discuss cardiovascular diseases or even diabetes and its risk factors".(P8)

“We attend the DCC meeting to discuss critical cases such as immunization and serious conditions like hepatitis and cholera”.(P5)

“...no, we usually don’t discuss cardiovascular diseases”.(P5)

However, a minority of the respondents indicated that data review sessions were not conducted or that they had never attended any data review session.

“we don’t do data reviews”.(P3)

“No, I have never attended a data review session”.(P6)

Sub-theme 3.2 Lack of standardised links between information provided on CVDs risk factors by health workers and subsequent health interventions.

Data captured on BMI, smoking, and alcohol usage are generally recorded but not used to determine further interventions unless the client is malnourished or has a history of TB. It is further revealed that obese clients are not monitored regardless of the outcome of their BMI and middle-upper-arm-circumference (MUAC). In the words of two of the respondents:

“We do not monitor clients who are obese although the parameters are taken”.(P2)

“...we will probably tell the client your BP is high or sometimes to look at the diet...but honestly speaking there is no standardised way of doing it”.(P11)

Another respondent confirmed that even though basic vital signs are captured, the lack of standardised practices contributes to data not being analysed, systematically interpreted, reported to various levels, or used for decision making. The following statement made by one of the respondents serves as evidence:

“Vital signs are always done, but you know we don’t do it to monitor cardiovascular diseases. That’s why I think these things should be standardised”.(P11)

Despite the limitations, the existing data collection systems are powerful tools for the surveillance of CVDs. Data on utilisation of CVD data for decision making is discussed next.

Theme 4: Utilisation of CVD data for decision making.

The researcher has operationally defined data utilisation as the use of data captured from PLHIV to inform programme decision making, and regular feedback is provided to ensure that the right data is captured, from the right target group, and for the right purpose. This theme has two sub-themes, and they are discussed below. Data utilisation is regarded as the use of data captured from PLHIV to inform programme decision making and provided regular feedback to ensure that the right data is captured, from the right target group and for the right purpose. Responses for this theme are discussed below.

Sub-theme 4.1 Lack of an integrated system that encourages regular, institutionalised feedback and the use of CVDs and its risk factors for subsequent interventions among PLHIV.

Generally, client health data is available, but the focus is not on data for CVDs risk factors or specifically cardiovascular diseases. The study has revealed that there is currently no documented harmonised system that encourages the utilisation of CVDs data and its risk factors to promote holistic care for PLHIV initiated on ART.

"But to date, no written feedback on reports were given to us". (P9)

"No system is focusing on alcohol usage and subsequent interventions".(P2)

"...data that are mostly used are from the QI projects". (P2)

"We have never done a data review meeting with DSP where we have only discussed and analysed parameters collected, captured and entered in ePMS to identify cardiovascular diseases".(P2)

"No, we do not send reports to the clinics but obviously if there is a disease outbreak that requires immediate attention, we find ways to communicate to the team like the WhatsApp group".(P10)

"Currently, we do not know how we are doing in terms of CVDs. The previous QI projects were learning sessions, but the project ended".(P2)

Sub-them 4.2 Insufficient analysis and usage of data to generate evidence-based information to reduce CVDs among PLHIV.

One health facility was used as a best practice of integrating hypertension into ART services, of which the interviewee participated in an article writing exercise. Information needs are not prioritised and often lacking because critical data is not analysed for further decision making. It was further revealed that data for BP, BMI, smoking, and alcohol history is only used when the patient's viral load is high. The expressions below emphasise the need for analysing and using of data which is captured routinely.

"As a health worker I will always talk to the clients about healthy living, but these are definitely not recorded anywhere".(P11)

"No system is focusing on alcohol usage and subsequent interventions".(P2)

Theme 5: Health system response and capacity to manage CVDs among PLHIV

Health systems' response is well defined, and the capacity of the current system is prepared, resilient, and well established to provide integrated services and capability

to address the burden of cardiovascular diseases at the facility level. This theme has two sub-themes.

Sub-theme 5.1 Inadequate capacity to manage CVDs and its risk factors among PLHIV.

The nurse mentor usually oversees the implementation of ART program services and clinical reporting at the facility level. The respondents indicated that all reported data is entered by the HIS and surveillance officer at the district level into DHIS2. It is further revealed that health workers who are responsible for CVDs risk factor data collection, analysis, and reporting are mostly data entry clerks and nurses. The health assistants are responsible for taking basic parameters such as blood pressure, weight, height, and MUAC after the patient has registered at the reception from PLHIV. Furthermore, the respondents indicated that they were not responsible for initiating BP treatment. They also expressed staff shortage as a concern that limits their service delivery. Some respondents revealed the following:

"The doctor will initiate the first BP treatment since we as nurses are not mandated to do that, but follow-up treatment is dispensed at the clinics". (P11)

"We have too many patients with few nurses who are doing the work. More nurses should be employed". (P11)

"We offer integrated services, but still, we have a specific date when the doctor comes. ANC and PNC clients also have specific days to come to the clinic like normal patients".(P3)

5.2 Inadequate data collections/parallel systems with no interoperability.

The study revealed that there are currently too many vertical programs with minimum interoperability, despite minimal efforts of harmonising various projects. A classic

example is the BP screening and treatment that was monitored for one year under the NAMPROPA pilot project whilst the NAMLIFE project focussed on viral load monitoring and suppression, IPT initiation, and those newly diagnosed with HIV.

These views were expressed:

"I am also involved in data management activities such as compiling reports for QA projects for such as HIVQual: IPT initiation and completion, Pap smear; NAMPROPA: LTFU, Viral load suppression, BP screening and treatment, while NAMLIFE focusses on viral load monitoring and suppression among those people between 15-24 years, IPT initiation and the ones who were newly diagnosed with HIV"(P2)

"...what happens is that we capture the data in the NAMLIFE book and enter it into the template or spreadsheet on our desktop and send it to Drz via email which in turns sends it to the MoHSS".(P10)

It was also revealed that the International Training and Education Center for Health (I-TECH) was currently busy with the consolidation and cleaning of datasets at specific health facilities.

In addition, the study revealed that there are currently many vertical programs with minimum interoperability, despite minimal efforts of harmonising various health projects. A typical example is the BP screening and treatment that was monitored for one year under the NAMPROPA pilot project whilst the NAMLIFE project focussed on viral load monitoring and suppression, IPT initiation, and those newly diagnosed with HIV.

Generally, surveillance is regarded as the most cost-effective strategy, but any sound system relies on people and user-friendly infrastructure for the provision of data that is complete, timely, appropriate, and trustworthy. Concerted efforts are effected to ensure the preparedness of health systems response to the integration of CVDs in its daily health care delivery. Figure 4.2 below summarises the various quotes and networks generated under theme 5, which deals with health systems' response and capacity to manage CVDs.

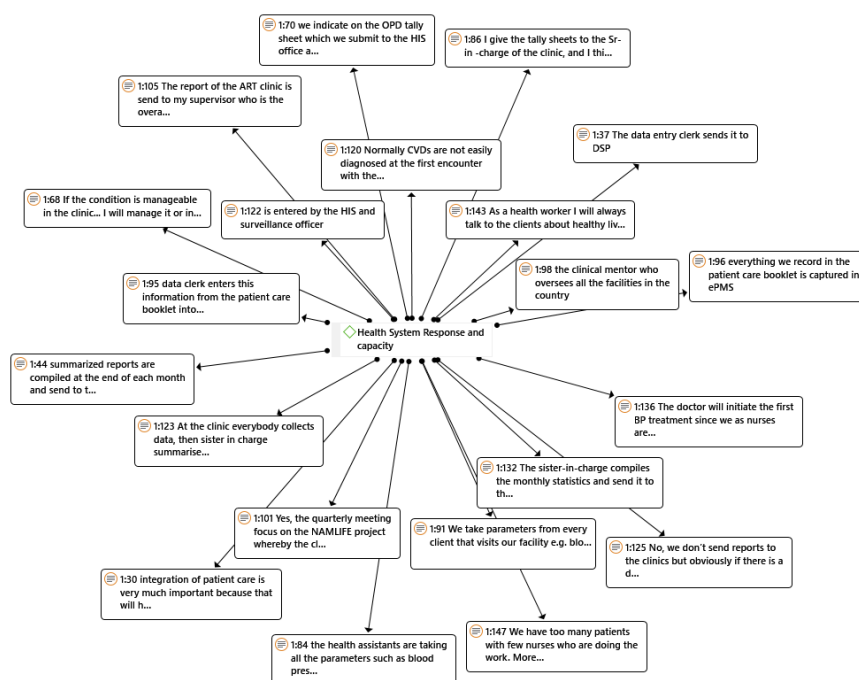


Figure 4.2: Health systems response and capacity to manage CVDs.

Theme 6: Guidelines, policies, and strategies on the integration of health information systems tracking and linking CVDs risk factors to PLHIV for subsequent clinical interventions.

For the purpose of this study, existing guidelines, standards, and policies are essential to progress markers. They ensure that both the quality or process of care and health outcomes for PLHIV who are at risk of developing cardiovascular diseases are prioritised. This theme has two sub-themes which are presented below.

Sub-theme 6.1 Lack of standardised/institutionalised strategies, policies, and guidelines to facilitate regular integrated CVDs risk factor surveillance and M&E among PLHIV.

There is a general concern that guiding documentation is in existence, but these are obviously not standardised. This could be a significant detriment to achieving integrated health care delivery for PLHIV into PHC settings. An understanding of the constraints deliberated on under this theme is a necessary first step toward integrated service delivery to PLHIV. The existing guidelines on the management of NCDs are outdated and not tailor-made to address current issues of CVDs in the context of those clients who are enrolled in and initiated into the ART programme. Furthermore, it was revealed that the extent to which policies/ strategies/guidelines from the MoHSS are instrumental in determining actions of HWs in providing integrated health care at a facility level, leaves much to be desired. The MoHSS has recently launched the National Multisectoral Strategic Plan for Prevention and Control of Non-Communicable Diseases (NCDs) in Namibia 2017/18 – 2021/22 in November 2018 (10)(35) (34). This theme has two sub-themes.

The respondents expressed the need for integration of CVDs in the existing service delivery.

“Integration of patient care is very much important because that will help us to deliver quality services to clients like obese patients since we don’t do anything about it currently”. (P2)

“...implementation of existing national documents in future might be one of the benefits that will come from such integration”. (P12)

Concerted efforts were made by the MoHSS to ensure that integrated service delivery becomes a reality at PHC facilities such as the adoption of the pilot World Health Organization Package of Essential Non-Communicable Disease Interventions (WHO PEN).

“We have adopted the World Health Organization Package of Essential Non-Communicable Disease Interventions (WHO PEN) for Primary Health Care in Low-Resource Settings to draft the national guidelines which will hopefully be integrated into all PHC programs”.(P12)

However, despite all this effort, health care workers at the peripheral levels of service provision are currently not aware of these national packages. In addition, the pilot QI projects which focusses on improving retention, viral load monitoring, viral load suppression, and hypertension screening and treatment among PLHIV on ART were terminated in 2018. Currently, the MoHSS relies on data from the 2013/2014 NHDS survey for data on cardiovascular diseases and other non-communicable diseases. This is evident from this statement:

“we are guided by the 2014 Namibia Demographic and Health Survey to determine the prevalence of NCDs”.(P12)

The immediate implication is that the dynamics of policies/strategies or guidelines employed or enforced to speed up regular integrated CVDs and its risk factors surveillance among PLHIV initiated on ART are not clearly understood by health workers. The next sub-theme also made mention of it.

Sub-theme 6.2 Lack of knowledge on the stipulations of the national strategy on NCDs to speed up regular integrated CVDs risk factor surveillance among PLHIV initiated on ART.

Health workers are not aware of the existence of the national strategy, which at times results in bottlenecks in terms of quality service delivery for PLHIV in a primary health care setting. This is amidst indications that the launching of the National Strategy on NCDs took place in 2018. Lack of knowledge on the existence of the National Strategy on NCDs to speed up regular integrated CVDs risk factor surveillance among PLHIV is hampering effective and efficient health care service delivery. The following are a few examples of the respondents' opinion on existing guiding documents:

“...but honestly speaking there is no standardised way of doing it”.(P11)
“I am not aware of any guidelines or policies that talk about only cardiovascular diseases among PLHIV”.(P4)
“We do not have hypertension guidelines”.(P5)
“The general hypertension guidelines are outdated, but it was developed in 2005”.(P9)
“I am not aware of policies or guiding documents specifically for cardiovascular diseases among PLHIV”. (P10)

This is a concern; the guidelines exist, but the people who are supposed to implement them are not aware of their existence. This could be attributed to either lack of proper communication and feedback from the management level or ignorance from the side of the implementers. Some of these challenges are discussed below.

4.2.3 Challenges and drawbacks experienced by healthcare workers.

Healthcare workers were asked about the challenges they are experiencing, specifically related to providing integrated services for PLHIV at their respective health facilities. They indicated that the inadequate harmonisation of data management practices, staff capacity, lack of documented feedback, and absence of the much-needed equipment such as a measuring tape and a baumanometer/sphygmomanometer were amongst the challenges they encountered. These challenges are reported verbatim in the passage below:

“...different facilities are doing different things e.g. clients with high viral loads are booked Fridays at this clinic; xx clinics instead give them treatment every day, and at other clinics, nurses are doing house-to-house visits”. (P2)

“Even in our tally sheets, there are a lot of things that are not captured that will enable us to make informed decisions”. (P3)

“New cases of HPT are not discussed, and statistics are not clearly collected”. (P3)

Some respondents indicated their challenges related to computers.

“It is usually computer-generated, but it has been a while since we have done it. This is mainly due to challenges with computers”. (P8).

“...the quantum database is new, and we are experiencing a few challenges e.g. we are unable to run reports yet unlike with the previous ePMS system”. (P9)

“...we can't extract data to give specific information related to the client. For example, if we follow-up blood results, we will have to look for it manually”. (P9)

Additionally, some interviewees indicated staff shortage and inadequate equipment as challenges in providing integrated services to PLHIV. This is evident from the following statements:

“Due to staff shortage, it is difficult to do HGT for each and every patient”. (P10)

“Remember also that baumanometers are also one of the challenges at the clinic. If it is not working or it is being used in one of the screening rooms than obviously BP will not be taken”. (P11)

“...basic equipment like measuring tapes is a challenge. Sometimes we can’t measure the BMI of a patient due to the absence of the measuring tape”.(P11)

“Yes, and capacity is also another challenge”.(P11)

Figure 4.3 summarises the various quotes and networks generated from the challenges and drawbacks pertaining risks of CVDs among PLHIV.

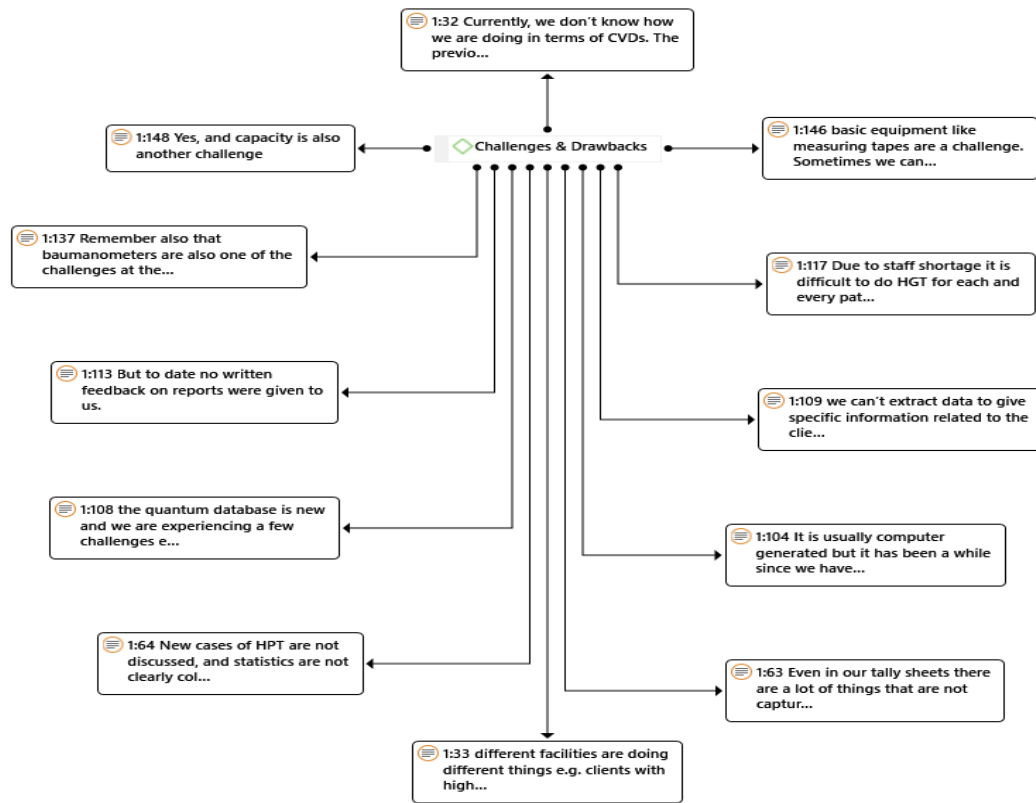


Figure 4.3: Challenges and drawbacks highlighted by key informants.

4.3 DISCUSSION OF QUALITATIVE FINDINGS

4.3.1 Introduction

Findings from the in-depth interviews are discussed below. The findings are discussed under the following related themes such as monitoring exposure of CVDs risk factors

among PLHIV; measuring health outcomes of CVDs risk factors among PLHIV; handling or managing of risk factor data (electronic and paper-based); utilisation of CVD data for decision making; health system response and capacity to manage CVDs among PLHIV and lastly, existing guidelines, policies, and strategies on the integration of clinical interventions for CVDs among PLHIV.

4.3.2 Theme 1: Monitoring exposure of CVDs risk factors among PLHIV

Monitoring of risk factors related to CVDs among PLHIV is critical in ensuring the continuum of care at all levels of health service delivery. The current study revealed that fragmented surveillance hampers the provision of integrated health service delivery to PLHIV initiated on ART. Several studies confirmed that HIV-infected patients commencing antiretroviral treatment might require regular hypertension screening and other cardiovascular risk assessments (9,173) such as cholesterol tests, hyperlipidaemia, and lifestyle assessments. Furthermore, this study found that screening tests for hypercholesterolemia, hyperlipidaemia and blood glucose are not routinely done. Notwithstanding, it has been suggested by Knudsen et al., that early detection of CVD risks reduces the chances of subclinical coronary atherosclerosis (7).

4.3.3 Theme 2: Measuring health outcomes of CVDs risk factors among PLHIV.

In terms of measuring health outcomes of CVDs risk factors among PLHIV, it is evident that parameters captured from a patient expedite the processes of integration, prompt referral, and targeted follow-up of those patients who are at risk of CVDs. Missed opportunities in terms of losing PLHIV due to systemic errors cannot be underestimated. Therefore, refining data management processes for integrating the tracking of patients who are lost to follow-up or who have exited the system through

death is advocated for by several researchers (51,79,173). This view is reiterated by Rice et al., who argues that PLHIV tracking over time and space creates a workable platform for targeted patient tracing across various health programs (48). As such, the researcher advocated for a similar approach in terms of integrating CVDs risk factor data collection, usage, and feedback into existing HIV platforms. Although no data was provided, the researcher agrees that a one-stop-shop patient-centred approach seems to be the most appropriate and efficient way of health care provision for all.

4.3.4 Theme 3: Inconsistent handling or managing of risk factor data for CVDs (electronic and paper-based)

Improper management of data is prone to numerous data quality issues experienced at health facilities. Findings under this theme concur with the assessment conducted by Measure Evaluation on data use barriers in the DRC (48). Lack of regular data quality checks and audits; centralised data management and analysis tasks; lack of emphasis on the review of data for M&E purposes or programme decision-making and limited or irregular dissemination of information (50,55,56) were among the key findings of various assessments done by Measure Evaluation. Similarly, lack of a data use culture, human resources challenges, and lack of supervision and coordination (49) were among the issues identified in the Côte d'Ivoire HIS Investment study. The researcher believes that bi-directional feedback establishes strong relationships between beneficiaries of the health services, data managers, and champions of strategic information at all levels of reporting.

4.3.5 Theme 4: Utilisation of CVD data for decision making.

On data utilisation, all targeted health facilities generate data summaries that are submitted to the PHC supervisor by the 5th of every month. However, using reliable data for decision making is compromised due to the lack of interoperable systems. Studies conducted in Zimbabwe (165), Malawi (174) and South Africa (173) revealed that inaccuracy and incompleteness of data hamper prompt decision making.

4.3.6 Theme 5: Health system response and capacity to manage CVDs among PLHIV.

Although risk factors for the development of CVDs were regularly collected by health workers, it is evident that there is no single nationwide surveillance system to consolidate current efforts. This finding is supported by the guidelines provided by the Institute of Medicine and CDC (14,76) which alludes to the absence of a single nationwide surveillance system despite regulated surveys, registries, and vital statistics that are used to complement the capturing of different kinds of information about chronic diseases. Similarly, to date, no comprehensive surveillance has been done on the existence of CVDs risk factors in Namibia. In addition, despite current efforts, little is known about surveillance systems that can provide reliable estimates of disease prevalence at each level of health care delivery (79) in Namibia.

4.3.7 Theme 6: Guidelines, policies, and strategies on the integration of health information systems tracking and linking CVDs risk factors to PLHIV for subsequent clinical interventions.

From the literature, it is evident that several international endorsements were ratified to ensure that the agenda for the NCDs receives the attention it deserves. Some

examples are the Moscow Declaration on NCDs in May 2011, the UN Political Declaration on NCDs in September 2011, the global monitoring framework and endorsed WHO Global Action Plan for the Prevention and Control of NCDs (2013-2020) (2,39,59,83).

4.4 SUMMARY OF QUALITATIVE FINDINGS

The study supports the need to develop a surveillance framework to track and predict cardiovascular disease risks and subsequent health outcomes for PLHIV initiated on ART in the Khomas region. Data quality management remains a priority for any health care service delivery. Respondents identified a range of issues that are currently hindering effective monitoring and evaluation. The findings from the study revealed that data collection efforts to determine the prevalence of health risk factors for CVDs are routinely made for all clients enrolled in the ART programme. Furthermore, the study revealed that the existing guidelines on the management of NCDs are not institutionalised and are outdated to address current issues of CVDs among PLHIV initiated on ART. As a result, data management processes are fragmented and inconsistent across various health facilities in the Khomas region.

4.5 PRESENTATION OF QUANTITATIVE FINDINGS

4.5.1 Introduction

This section presents the secondary data analysis. This quantitative data was extracted from the PCBs and ePMS data sources. The variables selection was informed by the qualitative sequential findings for objective 1a, as discussed in the previous section.

A pooled cross-sectional quantitative data from the patient care booklets (PCBs) between 2004-2017 was therefore used for this analysis. Data was matched with the

electronic Patient Monitoring System(ePMS), and statistical analyses were performed. It is a descriptive study design which was conducted to describe the most commonly found risk factors for CVDs and the patterns of its availability and completeness in the PCBs and ePMS.

4.5.2 Variable selection and justification

There is currently no documented data available on the prevalence of CVDs morbidity and mortality among PLHIV initiated on ART in the Khomas region. However, the researcher extracted the following CVD-specific risk factors such as blood pressure, body mass index (BMI), tobacco and alcohol use, from the Patient Care Booklet (PCB) as proxy indicators, and also to determine the magnitude of the risks of CVDs among PLHIV initiated on ART.

As indicated in the previous chapter, age was also considered as a significant predictor or detrimental factor of hypertension in the multivariable model by the researcher (128). The older one gets, the higher the risk of hypertension (163); hence, it is expected that one's blood pressure should be continuously monitored for follow-up interventions. Additionally, sex was also found to be a significant variable associated with hypertension (22,36).

BMI, smoking, and alcohol usage could not be used as the only standalone measure of risk factors for CVDs, but this was grouped and interpreted as discussed in chapter 3. Socio-demographic and programme data such as age, sex, marital status, blood pressure, overweight/obesity were obtained from the electronic patient monitoring system (ePMS) as independent variables at targeted health facilities in the Khomas region.

4.5.3 Inclusion exclusion criteria

For the health risk factors of cardiovascular diseases (CVDs) among PLHIV data extraction, the prevalence of health risk factors of cardiovascular diseases among 529 PLHIV initiated on ART was randomly selected from a total of 876 individuals who were enrolled in the ART programme. The researcher only considered those patients who were initiated on ART at the time of data extraction. Equally, the clients enrolled in the programme before January 2004 and after 2017 were excluded from the study. The data collection and analysis efforts for the ART programme was institutionalised in 2004 hence the inclusion of such cases. Furthermore, the piloting of the new Quantum database in the Khomas region in 2018 necessitated the exclusion of those patients registered after 2017. Baumgartsbrum clinic does not have registered PLHIV initiated on ART or an existing ePMS and was therefore also excluded from the study. These analyses are structured as follows:

4.5.4 Assessment of health risk factors associated with cardiovascular diseases among PLHIV initiated on ART.

The health risk factors of cardiovascular diseases (CVDs) among PLHIV initiated on ART will be presented below:

- Section 4.5.4.1: High systolic and diastolic blood pressure
- Section 4.5.4.2: Anthropometric indicators
- Section 4.5.4.3: Smoking and tobacco habits
- Section 4.5.4.4: Alcohol consumption

4.5.5 Patterns of data availability and completeness of risk factor data for cardiovascular diseases enrolled in the ART programme at selected health facilities.

- Section 4.5.5.1: Missing demographic and other systemic data

- Section 4.5.5.2: Poor data recording
- Section 4.5.5.3: True retention in ePMS

Commonly found risk factors for CVDs among PLHIV such as blood pressure, BMI, alcohol usage, and smoking, as well as the availability and completeness of risk factor data, are discussed as outcome variables in the subsequent sections.

4.5.4 ASSESSMENT OF HEALTH RISK FACTORS ASSOCIATED WITH CARDIOVASCULAR DISEASES AMONG PLHIV INITIATED ON ART

4.5.4.1 HIGH SYSTOLIC AND DIASTOLIC BLOOD PRESSURE

The association between the risk of high blood pressure and the following variables are discussed below:

- Sex and risk of high blood pressure (systolic and diastolic)
- Age and risk of high blood pressure (systolic and diastolic)
- Marital status and high blood pressure (systolic and diastolic)
- Anthropometric and high blood pressure (systolic and diastolic)
- Alcohol consumption and high blood pressure (systolic and diastolic)
- Smoking and tobacco habits and high blood pressure (systolic and diastolic)
- Quality of data recording and high blood pressure (systolic and diastolic)

Sex and risk of high blood pressure

The study sought to analyse the association between sex and the different level of high systolic and diastolic blood pressure among PLHIV in the Khomas health district.

Table 4.3 below indicates the association between sex and systolic and diastolic blood pressure combined, generally labelled as high blood pressure. A total of 46.6% of females are at risk due to high blood pressure, of which 53.4% are not at risk. From the total number of males, 43.5% are at risk whilst 56.5% are not at risk of high blood pressure. Both the Pearson Chi Square test (.504, p-value of 0.478) and Likelihood ratio (0.505, p-value of 0.477) has p-value values that reveal that these p-values have insufficient evidence to conclude that there is an association between sex and high blood pressure. It is unlikely that sex is influenced by high systolic blood pressure. This implies that the researcher failed to reject the null hypothesis and concludes that there is no relationship.

Table 4.3: Sex and risk of high blood pressure

	Sex	Risk High Blood Pressure		Total
		Not at Risk	At Risk	
Female	Count	167	146	313
	% within Gender	53.4%	46.6%	100.0%
Male	Count	122	94	216
	% within Gender	56.5%	43.5%	100.0%
Total	Count	289	240	529
	% within Gender	54.6%	45.4%	100.0%

Sig. 2-Sided: Pearson Chi Square 0.504; Likelihood Ratio 0.505

Age and risk of high systolic blood pressure

That researcher has categorised age as 1-10; 11-20; 21-30; 31-40; 41-50; 51-60; and 61+ years. The association between age and risk of high systolic and diastolic blood pressure among PLHIV in the Khomas region is presented below.

Table 4.4 below shows that 24% of the patients between the age group of 21-30 years are at risk of elevated/optimal blood pressure whilst 16.45% are classified at stage 2 high risk of systolic blood pressure. Furthermore, 40.5% of the patients between the ages of 41-50 years who are enrolled in the ART programme are at risk of high systolic

blood pressure, whilst only 2.5% of the patients who are 61 years and above are at risk of stage 2 systolic blood pressure. The findings of the study further revealed that 42.28% of the patients between this same age category are not at risk of high systolic blood pressure at all. The Pearson Chi-Square test (29.385, p-value of 0.260) and a Likelihood ratio test (30.467, 0.170), respectively which are all >0.05 significant level. This implies that the researcher failed to reject the null hypothesis and conclude that there is no significant relationship between age and high systolic blood pressure among PLHIV initiated on ART in the Khomas region.

Table 4.4: Age and high systolic blood pressure risk

Age-category		Risk of high Systolic Blood pressure				
		Not stated	Elevated (Optimal_ Risk)	No_High_ SBP_Risk	Stage 1 (Low_Risk)	Stage 2 (High_Risk)
0 - 10	Count	0	0	1	1	0
	% within Agecat	0.00%	0.00%	50.00%	50.00%	0.00%
	% within High_BP_Risk_SB	0.00%	0.00%	0.60%	1.90%	0.00%
11 - 20	Count	1	0	1	0	0
	% within Agecat	50.00%	0.00%	50.00%	0.00%	0.00%
	% within High_BP_Risk_SB	0.50%	0.00%	0.60%	0.00%	0.00%
21 - 30	Count	27	6	39	9	13
	% within Agecat	28.70%	6.40%	41.50%	9.60%	13.80%
	% within High_BP_Risk_SB	13.70%	24.00%	22.30%	17.00%	16.50%
31 - 40	Count	66	8	74	19	23
	% within Agecat	34.70%	4.20%	38.90%	10.00%	12.10%
	% within High_BP_Risk_SB	33.50%	32.00%	42.30%	35.80%	29.10%
41 - 50	Count	70	8	43	16	32
	% within Agecat	41.40%	4.70%	25.40%	9.50%	18.90%
	% within High_BP_Risk_SB	35.50%	32.00%	24.60%	30.20%	40.50%
51 - 60	Count	25	1	15	8	9
	% within Agecat	43.10%	1.70%	25.90%	13.80%	15.50%
	% within High_BP_Risk_SB	12.70%	4.00%	8.60%	15.10%	11.40%
61+	Count	8	2	2	0	2
	% within Agecat	57.10%	14.30%	14.30%	0.00%	14.30%
	% within High_BP_Risk_SB	4.10%	8.00%	1.10%	0.00%	2.50%
Total	Count	197	25	175	53	79
	% within Agecat	37.20%	4.70%	33.10%	10.00%	14.90%
	% within High_BP_Risk_SB	100.00%	100.00%	100.00%	100.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.206; Likelihood Ratio 0.170

Age and risk of high diastolic blood pressure

Table 4.5 below shows that no risk of high diastolic blood pressures was observed in the 0-10 years age group. However, 12.70% of the patients between the age group 51-60 years are at high risk of high diastolic blood pressure whilst 11.70% of the same age group are at optimal risk. In addition, 35.8% of the patients between the ages of 31-40 years are at high risk of elevated/optimal blood pressure whilst 28.2% were classified as high risk of diastolic blood pressure. Additionally, 39.4% and 32.3% of the patients between the age group 41-50 years were classified as high risk and optimal risk for high diastolic blood pressure, respectively.

The study further revealed that 27.5% of patients in the age category of 41-50 years are not at risk of high diastolic blood pressure. Only 4.2% of patients who are 61 years and above are at risk of high diastolic blood pressure. The Pearson Chi-Square test (11.466, p-value of 0.489) indicates a p-value >0.05 , which means there exists no significant relationship between age and high systolic blood pressure among PLHIV initiated on ART. Furthermore, the likelihood ratio test (11.951, p-value of 0.450) revealed/yields/shows a small ratio which means that it is less likely that age is influenced by high systolic blood pressure. This implies that the researcher failed to reject the null hypothesis and concludes that there is no relationship.

Table 4.5: Age and high diastolic blood pressure risk

Age-category		Risk of high Diastolic Blood pressure			Total
		High_Risk	No_High_DBP_Risk	Optimal_Risk	
0 - 10	Count	1	1	0	2
	% within Agecat	50.00%	50.00%	0.00%	100.00%
	% within High_BP_Risk_DB	1.40%	0.70%	0.00%	0.40%
11 - 20	Count	0	1	1	2
	% within Agecat	0.00%	50.00%	50.00%	100.00%
	% within High_BP_Risk_DB	0.00%	0.70%	0.30%	0.40%
21 - 30	Count	10	29	55	94
	% within Agecat	10.60%	30.90%	58.50%	100.00%
	% within High_BP_Risk_DB	14.10%	20.40%	17.40%	17.80%
31 - 40	Count	20	57	113	190
	% within Agecat	10.50%	30.00%	59.50%	100.00%
	% within High_BP_Risk_DB	28.20%	40.10%	35.80%	35.90%
41 - 50	Count	28	39	102	169
	% within Agecat	16.60%	23.10%	60.40%	100.00%
	% within High_BP_Risk_DB	39.40%	27.50%	32.30%	31.90%
51 - 60	Count	9	12	37	58
	% within Agecat	15.50%	20.70%	63.80%	100.00%
	% within High_BP_Risk_DB	12.70%	8.50%	11.70%	11.00%
61+	Count	3	3	8	14
	% within Agecat	21.40%	21.40%	57.10%	100.00%
	% within High_BP_Risk_DB	4.20%	2.10%	2.50%	2.60%
Total	Count	71	142	316	529
	% within Agecat	13.40%	26.80%	59.70%	100.00%
	% within High_BP_Risk_DB	100.00%	100.00%	100.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.489; Likelihood Ratio 0.450

Marital status and risk of high systolic blood pressure

The association between marital status and the risk of high systolic and diastolic blood pressure among PLHIV initiated on ART in the Khomas region is presented below.

A total of 88% of the single patients are at risk of elevated/optimal systolic high blood pressure whilst 78.50% are at risk of stage 2 high systolic blood pressure as depicted in table 4.6 below. The findings of the study further revealed that 19.00% of married people are at risk of stage 2 high systolic blood pressure of which 12.00% are at

elevated/optimal systolic risk compared to 7.40% of the married people who are not at risk of high systolic blood pressure. There is no association between marital status and high systolic blood pressure risk. The Pearson Chi-Square test (15.606, p-value of 0.048) indicates a p-value which is >0.05 significant threshold. This implies that the researcher concludes that there exists a meaningful relationship between marital status and high systolic blood pressure among PLHIV initiated on ART. This is confirmed by the Likelihood ratio test (16.651, p-value of 0.034) which shows that blood pressure is influenced by marital status.

Table 4.6: Marital status and high systolic blood pressure risk

Marital Status		High_BP_Risk_SB					Total
		Not stated	Elevated (Optimal_Risk)	No_High_SBP_Risk	Stage 1 (Low_Risk)	Stage 2 (High_Risk)	
Married	Count	22	3	13	6	15	59
	% within Marital Status	37.30%	5.10%	22.00%	10.20%	25.40%	100.00%
	% within High_BP_Risk_S B	11.20%	12.00%	7.40%	11.30%	19.00%	11.20%
Single	Count	164	22	143	44	62	435
	% within Marital Status	37.70%	5.10%	32.90%	10.10%	14.30%	100.00%
	% within High_BP_Risk_S B	83.20%	88.00%	81.70%	83.00%	78.50%	82.20%
Unknown	Count	11	0	19	3	2	35
	% within Marital Status	31.40%	0.00%	54.30%	8.60%	5.70%	100.00%
	% within High_BP_Risk_S B	5.60%	0.00%	10.90%	5.70%	2.50%	6.60%
Total	Count	197	25	175	53	79	529
	% within Marital Status	37.20%	4.70%	33.10%	10.00%	14.90%	100.00%
	% within High_BP_Risk_S B	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.048; Likelihood Ratio 0.034

Marital status and high diastolic blood pressure

These findings are similar to the results of high systolic blood pressure and marital status in which 78.90% of single patients are at high risk of high diastolic blood pressure. From the same category, 82.90% are at elevated/optimal risk of diastolic high blood pressure in table 4.7. Interestingly, 82.40% of single patients are not at risk of diastolic high blood pressure. The results also show that only 16.90% are at high risk of diastolic blood pressure. The Pearson Chi-Square test (5.321, the p-value of 0.256) and the likelihood ratio test (5.066, the p-value of 0.281) both show a p-value which is >0.05 significant threshold. The findings of the study revealed that there is no association between marital status and high diastolic blood pressure risk. This implies that the researcher failed to reject the null hypothesis and concludes that there is no relationship between marital status and high diastolic blood pressure among PLHIV initiated on ART.

Table 4.7: Marital status and high diastolic blood pressure risk

Marital Status		High_BP_Risk_DB			Total
		High_Risk	No_High_DBP_Risk	Optimal_Risk	
Married	Count	12	12	35	59
	% within Marital Status	20.30%	20.30%	59.30%	100.00%
	% within High_BP_Risk_DB	16.90%	8.50%	11.10%	11.20%
Single	Count	56	117	262	435
	% within Marital Status	12.90%	26.90%	60.20%	100.00%
	% within High_BP_Risk_DB	78.90%	82.40%	82.90%	82.20%
Unknown	Count	3	13	19	35
	% within Marital Status	8.60%	37.10%	54.30%	100.00%
	% within High_BP_Risk_DB	4.20%	9.20%	6.00%	6.60%
Total	Count	71	142	316	529
	% within Marital Status	13.40%	26.80%	59.70%	100.00%
	% within High_BP_Risk_DB	100.00%	100.00%	100.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.256; Likelihood Ratio 0.281

BMI (overweight/obesity) and risk of high systolic blood pressure

Variables like weight and height were extracted to determine the body mass index (BMI) and subsequently examine the impact of obesity among PLHIV. The researcher used a BMI of 25 or above to determine if the client is overweight and for a BMI of 30 or above the client was classified as obese as indicated below:

Classification of BMI is as follows:

- Underweight: <18
- Normal weight: 18 -24.9
- Overweight: 25-<30
- Obese: ≤ 30

The analysis of BMI and risk of high systolic and diastolic blood pressure among PLHIV initiated on ART in the Khomas region is presented below.

Table 4.8 below shows that 4% of the elevated/optimal risk patients are underweight whilst 44% have a healthy weight. On the other hand, of those patients who have no risk of high systolic blood pressure, 55.5% of them have a healthy weight whilst 4% are obese, yet they have no high systolic blood pressure risk. The findings also revealed that of those patients who have a healthy weight, 54.70% and 48.10% are presented with stage 1 (low risk) and stage 2 (high risk) systolic blood pressure, respectively. The Pearson Chi-Square test (164.911) and the likelihood ratio test (162.295) both show a p-value of 0.001, which is <0.05 threshold or 95% confidence level. This implies that the researcher rejects the null hypothesis and concludes with 99.99% confidence that there exists a positive relationship between anthropometric indicators (BMI) and high systolic blood pressure and that systolic blood pressure is dependent on BMI.

Table 4.8: Anthropometric indicators and high systolic blood pressure risk

Anthropometric indicators		Risk of high Systolic Blood pressure					Total
		Not stated	Elevated (Optimal_Risk)	No_High_SBP_Risk	Stage 1 (Low_Risk)	Stage 2 (High_Risk)	
<18_Underweight	Count	5	1	26	2	6	40
	% within Anthrom_indic	12.50%	2.50%	65.00%	5.00%	15.00%	100.00%
	% within High_BP_Risk_SB	2.50%	4.00%	14.90%	3.80%	7.60%	7.60%
18-24 (Normal_Weight)	Count	54	11	97	29	38	229
	% within Anthrom_indic	23.60%	4.80%	42.40%	12.70%	16.60%	100.00%
	% within High_BP_Risk_SB	27.40%	44.00%	55.40%	54.70%	48.10%	43.30%
25-30 (Over_Weight)	Count	11	7	23	11	18	70
	% within Anthrom_indic	15.70%	10.00%	32.90%	15.70%	25.70%	100.00%
	% within High_BP_Risk_SB	5.60%	28.00%	13.10%	20.80%	22.80%	13.20%
30+ (Obese)	Count	4	1	7	6	5	23
	% within Anthrom_indic	17.40%	4.30%	30.40%	26.10%	21.70%	100.00%
	% within High_BP_Risk_SB	2.00%	4.00%	4.00%	11.30%	6.30%	4.30%
Not stated	Count	123	5	22	5	12	167
	% within Anthrom_indic	73.70%	3.00%	13.20%	3.00%	7.20%	100.00%
	% within High_BP_Risk_SB	62.40%	20.00%	12.60%	9.40%	15.20%	31.60%
Total	Count	197	25	175	53	79	529
	% within Anthrom_indic	37.20%	4.70%	33.10%	10.00%	14.90%	100.00%
	% within High_BP_Risk_SB	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

BMI (overweight/obesity) and risk of diastolic blood pressure

A total of 56.50% of the patients initiated into the ART programme are overweight and have an optimal risk of high diastolic blood pressure, as depicted in table 4.9 below. Of these patients, 22.50% are at a high risk of diastolic blood pressure. Also

noted is that 42.30% and 38.00% of the patients are of healthy weight, yet they are at high risk of diastolic blood pressure and optimal risk, respectively. The Pearson Chi-Square test (62.864) and the likelihood ratio test (65.121) both show a p-value of .001, which is <0.05 threshold or 95% confidence level. This implies that the researcher rejects the null hypothesis and concludes with 99.99% confidence that there exists a positive relationship between anthropometric indicators (BMI) and high diastolic blood pressure and that diastolic blood pressure is dependent on BMI.

Table 4.9: Anthropometric status and high diastolic blood pressure risk

Anthrometric_indicators		Risk of high Systolic Blood pressure			Total
		High_Risk	No_High_DBP_Risk	Optimal_Risk	
<18_Underweight	Count	9	17	14	40
	% within Anthrom_indic	22.50%	42.50%	35.00%	100.00%
	% within High_BP_Risk_DB	12.70%	12.00%	4.40%	7.60%
18-24 (Normal_Weight)	Count	30	79	120	229
	% within Anthrom_indic	13.10%	34.50%	52.40%	100.00%
	% within High_BP_Risk_DB	42.30%	55.60%	38.00%	43.30%
25-30 (Over_Weight)	Count	16	22	32	70
	% within Anthrom_indic	22.90%	31.40%	45.70%	100.00%
	% within High_BP_Risk_DB	22.50%	15.50%	10.10%	13.20%
30+ (Obese)	Count	6	4	13	23
	% within Anthrom_indic	26.10%	17.40%	56.50%	100.00%
	% within High_BP_Risk_DB	8.50%	2.80%	4.10%	4.30%
Not stated	Count	10	20	137	167
	% within Anthrom_indic	6.00%	12.00%	82.00%	100.00%
	% within High_BP_Risk_DB	14.10%	14.10%	43.40%	31.60%
Total	Count	71	142	316	529
	% within Anthrom_indic	13.40%	26.80%	59.70%	100.00%
	% within High_BP_Risk_DB	100.00%	100.00%	100.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

Alcohol usage and risk of systolic blood pressure

The analysis of alcohol usage and the risk of high systolic and diastolic blood pressure among PLHIV initiated on ART in the Khomas region is presented below.

The results in table 4.10 showed that of those patients who are active on ePMS and alcohol consumption of 44%, 41.50%, and 43% % are not at risk considering the different levels of risk of high systolic blood pressure such as elevated (Optimal_Risk), Stage 1 (Low_Risk) and Stage 2 (High_Risk). From the total patients who are active on the system, 20% are at risk of elevated systolic blood pressure, of which 12.70% are rated at risk of Stage 2 (High_Risk) systolic blood pressure. The findings further revealed that 20.80% are at low risk compared to 29.70% who are not at risk of high systolic blood pressure at all. The results of the study revealed that there is a significant association between alcohol consumption and high systolic blood pressure risk. This is confirmed by the Pearson Chi-Square test (77.802) and the likelihood ratio test (79.902), which both show a p-value of 0.001, respectively, which is <0.05 significant threshold. This implies that the researcher rejects the null hypothesis and concludes with 99.99% confidence that there exists a positive relationship between anthropometric indicators (BMI) and high systolic blood pressure and that systolic blood pressure is dependent on BMI.

Table 4.10: Alcohol use and high systolic blood pressure risk

At_Risk_Alcohol		High Systolic Blood Pressure Risk					Total
		Not stated	Elevated (Optimal_Risk)	No_High_SBP_Risk	Stage 1 (Low_Risk)	Stage 2 (High_Risk)	
No	Count	44	11	83	22	34	194
	% within At_Risk_Alcohol	22.70%	5.70%	42.80%	11.30%	17.50%	100.00%
	% within High_BP_Risk_SB	22.30%	44.00%	47.40%	41.50%	43.00%	36.70%
Yes	Count	22	5	52	11	10	100
	% within At_Risk_Alcohol	22.00%	5.00%	52.00%	11.00%	10.00%	100.00%
	% within High_BP_Risk_SB	11.20%	20.00%	29.70%	20.80%	12.70%	18.90%
Not_recorded_PCB	Count	131	9	40	20	35	235
	% within At_Risk_Alcohol	55.70%	3.80%	17.00%	8.50%	14.90%	100.00%
	% within High_BP_Risk_SB	66.50%	36.00%	22.90%	37.70%	44.30%	44.40%
Total	Count	197	25	175	53	79	529
	% within At_Risk_Alcohol	37.20%	4.70%	33.10%	10.00%	14.90%	100.00%
	% within High_BP_Risk_SB	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

Smoking and risk of high systolic blood pressure

The analysis of smoking and the risk of high systolic and diastolic blood pressure among PLHIV initiated on ART in the Khomas region is presented below.

It is revealed in Table 4.11 that 5.10% of the people that smoke tobacco products are at Stage 2 (High_Risk) of which 8.00% are presented with Elevated (Optimal_Risk). Furthermore, the study also revealed that 56.00% and 62.30% are at risk of Elevated (Optimal_Risk) and Stage 1(Low_Risk) although they do not smoke. The findings revealed that 15.40% of the patients who are at risk of Stage 2 high systolic blood

pressure are within the risk bracket of smoking. An enormous 66.00% of the total patients' smoking history was not recorded in the PCBs. Furthermore, 53.20% of these patients are at risk of diastolic blood pressure regardless of their smoking history. The Pearson Chi-Square test (76.888) and the likelihood ratio test (80.969) is rated at a p-value of 0.001 and 0.001 respectively, which is >0.05 threshold, and there is enough evidence to conclude that there is a relationship between the smoking of tobacco products and high systolic blood pressure. This implies that the researcher rejects the null hypothesis and finds with 99.99% confidence that there is a relationship between the smoking of tobacco products and high systolic blood pressure.

Table 4.11: Smoking habits and high systolic blood pressure risk

At_Risk_Smoke		High_BP_Risk_SB					Total
		Not stated	Elevated (Optimal _Risk)	No_High_ SBP_Risk	Stage 1 (Low_Risk)	Stage 2 (High_Risk)	
No	Count	63	14	118	33	42	270
	% within At_Risk_Smoke	23.30%	5.20%	43.70%	12.20%	15.60%	100.00 %
	% within High_BP_Risk_ SB	32.00%	56.00%	67.40%	62.30%	53.20%	51.00 %
Yes	Count	4	2	16	0	4	26
	% within At_Risk_Smoke	15.40%	7.70%	61.50%	0.00%	15.40%	100.00 %
	% within High_BP_Risk_ SB	2.00%	8.00%	9.10%	0.00%	5.10%	4.90%
Not recor ded_PCB	Count	130	9	41	20	33	233
	% within At_Risk_Smoke	55.80%	3.90%	17.60%	8.60%	14.20%	100.00 %
	% within High_BP_Risk_ SB	66.00%	36.00%	23.40%	37.70%	41.80%	44.00 %
Total	Count	197	25	175	53	79	529
	% within At_Risk_Smoke	37.20%	4.70%	33.10%	10.00%	14.90%	100.00 %
	% within High_BP_Risk_ SB	100.00%	100.00 %	100.00%	100.00%	100.00%	100.00 %

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

Smoking and risk of high diastolic blood pressure

The study findings revealed that 47.90% of the people who do not smoke tobacco products are at high risk of high diastolic blood pressure of which 3.20% of the patients who smoke tobacco products are at risk of elevated diastolic blood pressure as presented in table 4.12 below. It is further revealed that 51.5% do not smoke, but they are at Optimal risk for high diastolic pressure compared to 12.60% who do not smoke yet they are at high risk of diastolic blood pressure. A total of 47.90% of those patients who do not smoke are at risk of elevated diastolic blood pressure. Both the Pearson Chi-Square test (76.888) and the likelihood ratio test (80.969) show a p-value of 0.001 and 0.001 respectively which is <0.05 threshold, thus there is enough evidence to conclude that there is a relationship between the smoking of tobacco products and high systolic and diastolic blood pressure. This implies that the researcher rejects the null hypothesis and concludes with 99.99% confidence that exists a relationship between smoking habits and high diastolic blood pressure.

Table 4.12: Smoking habits and high diastolic blood pressure risk

At_Risk_Smoke	High_BP_Risk_DB				
	High_Risk	No_High_DBP_Risk	Optimal_Risk	Total	
No	Count	34	97	139	270
	% within At_Risk_Smoke	12.60%	35.90%	51.50%	100.00%
	% within High_BP_Risk_DB	47.90%	68.30%	44.00%	51.00%
Yes	Count	5	11	10	26
	% within At_Risk_Smoke	19.20%	42.30%	38.50%	100.00%
	% within High_BP_Risk_DB	7.00%	7.70%	3.20%	4.90%
Not_recorded_PCB	Count	32	34	167	233
	% within At_Risk_Smoke	13.70%	14.60%	71.70%	100.00%
	% within High_BP_Risk_DB	45.10%	23.90%	52.80%	44.00%
Total	Count	71	142	316	529
	% within At_Risk_Smoke	13.40%	26.80%	59.70%	100.00%
	% within High_BP_Risk_DB	100.00%	100.00%	100.00%	100.00%

Fig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

Analysis of quality of data recording and high blood pressure risk

Among all the patients in the ART programme, 76.2% of those presented with poor records are at risk of high blood pressure. It is evident from the statistics in Table 4.13 below that only 23.8% with poor records are not at risk of high blood pressure. It further reveals that 66.9% of those with good quality records are not at risk of high blood pressure compared to 31.1% who are at risk of high blood pressure in the same cohort. Both the Pearson Chi-Square test (80.830) and Likelihood ratio test (83.127) show a p-value of 0.001, which is <0.05 significant threshold. Thus, there is enough evidence to conclude that there is a relationship between patients initiated into the ART programme, but whose records are poorly recorded. This implies that the researcher rejects the null hypothesis and concludes with 99.99% confidence that there exists a relationship between the quality of data recorded and high blood pressure.

Table 4.13: Data recording and high blood pressure risk

Data_Recording		High Blood Pressure Risk		
		<i>Not at Risk</i>	<i>At-Risk</i>	<i>Total</i>
Poor records	Count	36	115	151
	% within Data_Record	23.8%	76.2%	100.0%
Good Records	Count	253	125	378
	% within Data_Record	66.9%	33.1%	100.0%
Total	Count	289	240	529
	% within Data_Record	54.6%	45.4%	100.0%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

4.5.4.2 BODY MASS INDEX (BMI)

As indicated above, weight and height were extracted to determine the body mass index (BMI) and subsequently examine the impact of obesity among PLHIV initiated on ART in the Khomas region. The BMI of 25 or above to were classified as overweight and ≤ 30 as obese.

The association between sex, marital status, actual retention, data recording, smoking, and risk of anthropometric indicators among PLHIV initiated on ART in the Khomas region is presented below.

Sex and BMI

The results showed that 39.9% of the females are at risk of increased BMI compared to 43.1% of the males are at risk of increased BMI. Furthermore, 60.1% of females are not at risk of increased BMI in comparison to 56.9% males as indicated in table 4.14 below. Both the Pearson Chi-Square test (.513) and Likelihood ratio test (.513) show a p-value of 0.474, which is >0.05 significant threshold. This implies that there is no relationship between sex and increased BMI; thus, the researcher failed to reject the null hypothesis.

Table 4.14: Sex and anthropometric indicators risk

	Sex	Risk_Anthropometric indicators		Total
		Not AT Risk	At-Risk	
Female	Count	188	125	313
	% within Gender	60.1%	39.9%	100.0%
Male	Count	123	93	216
	% within Gender	56.9%	43.1%	100.0%
Total	Count	311	218	529
	% within Gender	58.8%	41.2%	100.0%

Sig. 2-sided: Pearson Chi-Square 0.474; Likelihood Ratio 0.474

Marital status and BMI

Table 4.15 below shows that at least 41.1% of married patients are at risk of increased BMI compared to single patients who are rated at 40.2%. A total of 55.9% of the married and 59.8% of individual patients are not at risk of increased BMI. The Pearson Chi-Square test (.318) shows a p-value of 0. 573, whilst the Likelihood ratio (0.316) shows a p-value of 0.574, which is >0.05 significant threshold. This implies that there is no significant association between marital and increased BMI; thus, the researcher failed to reject the null hypothesis.

Table 4.15: Marital status and anthropometric indicators risk

	Marital_Status	Risk_anthropometric Indicators		Total
		Not At Risk	At-Risk	
Married	Count	33	26	59
	% within Marital_Status	55.9%	44.1%	100.0%
Single	Count	238	160	398
	% within Marital_Status	59.8%	40.2%	100.0%
Total	Count	271	186	457
	% within Marital_Status	59.3%	40.7%	100.0%

Sig. 2-sided: Pearson Chi-Square 0.573; Likelihood Ratio 0.574

True retention and BMI

The researcher wanted to find out whether there is an association between a patient who is active in ePMS or those who are lost from the system either through death, transfer-out, or lost-to-follow-up and increased BMI. Table 4.16 below shows that a total of 60.00% of the patients who are enrolled in the ART programme is lost or not accounted for in the system, are at risk of increased BMI. Furthermore, a total of 66.60% of the cohort who are active in the ePMS is not at risk of increased BMI. Both the Pearson Chi-Square test (31.950) and Likelihood ratio test (31.708) show a p-value of 0.001, respectively which is <0.05 significant threshold. Thus, there is enough evidence to conclude that there is a relationship between patient retention in ePMS and anthropometric indicators. This implies that the researcher rejects the null hypothesis and finds with 99.99% confidence that exists a relationship between patient retention and increased BMI.

Table 4.16: True retention and BMI

True_Retention		BMI		Total
		Not AT Risk	At-Risk	
Active	Count	249	125	374
	% within True_Retention	66.60%	33.40%	100.00%
Lost	Count	62	93	155
	% within True_Retention	40.00%	60.00%	100.00%
Total	Count	311	218	529
	% within True_Retention	58.80%	41.20%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

Data quality recording and BMI

From the total sampled patients, 16.60% are at risk of increased BMI whilst 83.40% are not at risk, but their records are poorly managed as depicted in Table 4.17. The results show that there was a significant association between patients initiated into the ART programme, and those whose records are sparse and BMI since the Pearson Chi-

Square test (53.014) and Likelihood ratio test (57.533) shows p-values of 0.001 each, which is <0.05 significant threshold. Therefore, the researcher rejects the null hypothesis and concludes with 99.99% confidence that exists a relationship between the quality of data recorded and anthropometric indicators.

Table 4.17: Data Quality recording and BMI

Data_Recording		BMI		Total
		Not At Risk	At-Risk	
Poor records	Count	126	25	151
	% within Data_Record	83.40%	16.60%	100.00%
Good Records	Count	185	193	378
	% within Data_Record	48.90%	51.10%	100.00%
Total	Count	311	218	529
	% within Data_Record	58.80%	41.20%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

Although 51.10% of those PLHIV initiated on ART presented with an increased BMI, there was no documented proof that alternative health service was provided to this group of people.

Smoking and BMI

The results show in Table 4.18 below that a total of 40.20% do not smoke but are at risk of increased BMI, while 48.00% smoke and are also at risk of smoking. Furthermore, 59.80% of non-smokers and 52.00% of smokers are not at risk of increased BMI. The Pearson Chi-Square test (.573) and the Likelihood ratio test (0.566) shows a p-value of 0.449 and 0.452, respectively, which is >0.05 threshold. Therefore, the researcher failed to reject the null hypothesis and concludes that there is no significant relationship between smoking and BMI. Furthermore, it is unlikely that smoking influences BMI in PLHIV initiated on ART.

Table 4.18: Smoking habits and BMI

Smoking and tobacco habits	BMI		Total	
	Not At Risk	At-Risk		
Don't smoke	Count	162	109	271
	% within Smoke	59.80%	40.20%	100.00%
Smoke	Count	13	12	25
	% within Smoke	52.00%	48.00%	100.00%
Total	Count	175	121	296
	% within Smoke	59.10%	40.90%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.449; Likelihood Ratio 0.452

4.4.4.3 LINK BETWEEN SMOKING, SOCIO-DEMOGRAPHIC AND SYSTEMIC INDICATORS

An analysis was done on sex, marital status, actual retention, the total average of follow-up (FP) days, quality of data recording, anthropometric indicators, alcohol consumption, and risk of smoking among PLHIV initiated on ART in the Khomas region is presented below.

Sex and smoking

The findings revealed that 94.20% female and 88.70% of male patients are not at a smoking risk, as shown in Table 4.19 below. From the targeted cohort, 5.80% of females and 11.30% of males are smokers. The Pearson Chi-Square test (2.810) and a Likelihood ratio test (2.833) shows a p-value of 0.094 and 0.092, respectively, which is >0.05 threshold. Therefore, the researcher failed to reject the null hypothesis and concludes that there is no significant relationship between sex and smoking.

Table 4.19: Sex and smoking habits risk

	Sex	Smoking risk (broad)		Total
		Don't smoke	Smoke	
Female	Count	145	9	154
	% within Gender	94.20%	5.80%	100.00%
Male	Count	126	16	142
	% within Gender	88.70%	11.30%	100.00%
Total	Count	271	25	296
	% within Gender	91.60%	8.40%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.094; Likelihood Ratio 0.092

Marital and smoking risk

The results show that 95.00% of married people do not smoke and only 5.00% are smokers and are at potential risk. Besides, 90.90% of single patients are not at risk of smoking, while 9.10% are at risk of smoking as depicted in table 4.20 below. The Pearson Chi-Square test (.731) and Likelihood ratio (0.827) shows a p-value of 0.392 and 0.363, respectively, which is >0.05 threshold. Therefore, the researcher failed to reject the null hypothesis and concludes that there is no significant relationship between sex and smoking.

Table 4.20: Marital status and smoking habits

Marital_Status		Smoking risk (broad)		Total
		Don't smoke	Smoke	
Married	Count	38	2	40
	% within Marital_Status	95.00%	5.00%	100.00%
Single	Count	200	20	220
	% within Marital_Status	90.90%	9.10%	100.00%
Total	Count	238	22	260
	% within Marital_Status	91.50%	8.50%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.392; Likelihood Ratio 0.363

Analysis of total average of follow-up (FP) days and smoking (broad) risk

Table 4.21 below depicts that 93.30% non-smokers versus 6.70% of smokers were followed-up for 30 days or less, 75.00% of non-smokers versus 5.00% of smokers were followed-up for between 31-60 days while 84.40% non-smokers versus 13.60% smokers were followed-up for 61 days or more. The Pearson Chi-Square test (6.227) and Likelihood ratio (6.043) shows a p-value of 0.044 and 0.049 respectively, which is >0.05 threshold. Therefore, the researcher failed to reject the null hypothesis and concludes that there is a significant relationship between smoking and the total average of FP days.

Table 4.21: Follow-up days and Smoking risk

FP_Days		Smoking risk (broad)		
		Don't smoke	Smoke	Total
Days 30 and below	Count	42	3	45
	% within FP_Days	93.30%	6.70%	100.00%
Days 31 to 60	Count	134	7	141
	% within FP_Days	95.00%	5.00%	100.00%
Days 61 and above	Count	95	15	110
	% within FP_Days	86.40%	13.60%	100.00%
Total	Count	271	25	296
	% within FP_Days	91.60%	8.40%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.044; Likelihood Ratio 0.049

Analysis of true retention and smoking (broad) risk

The study findings revealed that a total of 92.50% do not smoke, are active, and therefore are not at risk of being lost in the ART programme compared to 7.50% who smoke and are still active in the system. In addition, 89.70% do not smoke but are lost while 8.40% smokes and are also at risk of not being retained in the system. The Pearson Chi-Square test (.648) and Likelihood ratio (0.629) shows a p-value of 0.421 and 0.428, respectively, which is >0.05 threshold, as shown in table 4.22. Therefore, the researcher failed to reject the null hypothesis and concludes that there is no relationship between retention in ePMS and a patient who is a smoker.

Table 4.22: True retention and smoking habits risk

True_Retention		Smoking risk (broad)		Total
		Don't smoke	Smoke	
Active	Count	184	15	199
	% within True_Retention	92.50%	7.50%	100.00%
Lost	Count	87	10	97

	% within True_Retention	89.70%	10.30%	100.00%
Total	Count	271	25	296
	% within True_Retention	91.60%	8.40%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.241; Likelihood Ratio 0.428

Analysis of quality of data recording and smoking (broad) risk

The results in table 4.23 below show that among all the patients in the ART programme, only 3.5% of those presented with poor records are smokers, while 10.50% have good records. Furthermore, 96.50% of those who do not smoke have poor records compared to 89.50% who do not smoke but whose files indicate that records are properly documented. The Pearson Chi-Square test (3.853) and the likelihood ratio test (4.495) shows a p-value of 0.050 and 0.034, respectively, which is equal to the 0.05 threshold. Therefore, the researcher concluded that there is a significant relationship between the quality of data recorded and a patient who is a smoker.

Table 4.23: Quality of data recording and smoking habits risk

Data_Record		Smoking risk (broad)		Total
		Don't smoke	Smoke	
Poor records	Count	83	3	86
	% within Data_Record	96.50%	3.50%	100.00%
Good Records	Count	188	22	210
	% within Data_Record	89.50%	10.50%	100.00%
Total	Count	271	25	296
	% within Data_Record	91.60%	8.40%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.050; Likelihood Ratio 0.034

4.5.4.4 ANALYSIS OF ALCOHOL CONSUMPTION

The association between sex, marital status, true retention, the total average of follow-up (FP) days, last ART status, quality of data recording, anthropometric indicators, smoking, and risk of alcohol consumption among PLHIV initiated on ART in the Khomas region is presented below.

Analysis of sex and alcohol consumption (broad) risk

Thirty-two percent of the females and 34% of the males take alcohol and are likely to be at risk due to alcohol consumption as depicted in table 4.24 below. However, 63.20% of males and 68.00% are not at risk due to alcohol consumption. The Pearson Chi-Square test (.752) and the Likelihood ratio test (0.750) both show a p-value of 0.386, which is >0.05 threshold. Therefore, the researcher failed to reject the null hypothesis and concludes that there is no significant relationship between sex and alcohol consumption.

Table 4.24: Sex and alcohol consumption risk

	Sex	Alcohol consumption		Total
		Don't drink Alcohol	Drink Alcohol	
Female	Count	115	54	169
	% within Gender	68.00%	32.00%	100.00%
Male	Count	79	46	125
	% within Gender	63.20%	36.80%	100.00%
Total	Count	194	100	294
	% within Gender	66.00%	34.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.386; Likelihood Ratio 0.386

Analysis of sex and alcohol consumption

The results in table 4.25 below show that 34.60% of married people who consume alcohol are likely to be at risk of CVDs compared to 65.50% of the same cohort who are not at risk due to alcohol consumption. It is also revealed that 66.50% of the single patients are not at risk due to alcohol consumption, while 33.50% are at risk. With a p-value of 0.907 shown by both the Pearson Chi-Square test (.014) and Likelihood ratio (0.014), there is no significant association between sex and alcohol consumption.

Table 4.25: Marital status and alcohol consumption

Marital_Status		Alcohol consumption		Total
		Don't drink Alcohol	Drink Alcohol	
Married	Count	17	9	26
	% within Marital_Status	65.40%	34.60%	100.00%
Single	Count	155	78	233
	% within Marital_Status	66.50%	33.50%	100.00%
Total	Count	172	87	259
	% within Marital_Status	66.40%	33.60%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.907; Likelihood Ratio 0.907

Analysis of total average follow-up days and alcohol consumption

The results in table 4.26 indicates that of the total targeted patients, 44.10% with 30 days and below takes alcohol while only 35.60% of those with 31-60 days take alcohol, and 30.30% of those with 61 days and above follow-up days. In addition, 55.90% were presented with <30 follow-up days, 6.40% of those with 31-60 follow-up days and 69.70% of those who have ≥ 61 follow-up days, are not at risk of alcohol consumption. The Pearson Chi-Square test (2.559) shows a p-value of 0. 274, which is >0.05 threshold, and the Likelihood ratio (2.515) has a p-value of 0.284. Therefore, the researcher failed to reject the null hypothesis and concludes that there is no significant relationship between patient total average follow-up days and alcohol consumption. The researcher was unable to reject the null hypothesis and concludes that there is no meaningful relationship between patient full average follow-up days and alcohol consumption.

Table 2.26: Follow-up days and alcohol consumption risk

FP_Days		Alcohol consumption		Total
		Don't drink Alcohol	Drink Alcohol	
Days 30 and below	Count	19	15	34
	% within FP_Days	55.90%	44.10%	100.00%
Days 31 to 60	Count	76	42	118
	% within FP_Days	64.40%	35.60%	100.00%
Days 61 and above	Count	99	43	142
	% within FP_Days	69.70%	30.30%	100.00%
Total	Count	194	100	294
	% within FP_Days	66.00%	34.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.274; Likelihood Ratio 0.284

Analysis of last ART status and alcohol consumption

The findings of the study in table 4.27 show that of the 191 patients still on ART treatment, 60.70% do not drink alcohol whilst 39.30% consume alcohol. Furthermore, of the 75% of patients that have been lost to follow-up, 76.00% of them do not drink alcohol while 24.00% drinks alcohol, respectively. The researcher concluded that there is a significant relationship between the last ART status and alcohol consumption since the Pearson Chi-Square test (6.713) shows a p-value of 0.035 and a Likelihood ratio (6.917) which is presented with a p-value of 0.031. Both tests are above the threshold of >0.05 significance level.

Table 4.27: Last ART status and Alcohol consumption

<i>Last ART Status</i>		<i>Alcohol consumption</i>		<i>Total</i>
		Don't drink Alcohol	Drink Alcohol	
Patient on pre ART	Count	21	7	28
	% within Last ART Status	75.00%	25.00%	100.00%
Patient lost to follow	Count	57	18	75
	% within Last ART Status	76.00%	24.00%	100.00%
Patient on treatment	Count	116	75	191
	% within Last ART Status	60.70%	39.30%	100.00%
Total	Count	194	100	294
	% within Last ART Status	66.00%	34.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.035; Likelihood Ratio 0.031

Analysis of true retention and alcohol consumption (broad) risk

It is revealed in the study findings that 36.40% of the patients are active and retained in the system and yet are at risk of consuming alcohol, Of these 25.80% who are lost and at risk of alcohol consumption as shown in table 4.28 below. Furthermore, 74.20% of those patients are lost and 63.60% are active in the system and not at risk of alcohol consumption. The Pearson Chi-Square test (2.585) and Likelihood ratio (2.674) shows a p-value of 0.108 and 0.102 respectively, which is above the threshold of >0.05 significance level. Therefore, the researcher concluded that there is no significant association between a patient being retained in the ePMS and the risk of alcohol consumption.

Table 4.28: True retention and alcohol consumption risk

True_Retention		Alcohol consumption		Total
		Don't drink Alcohol	Drink Alcohol	
Active	Count	145	83	228
	% within True_Retention	63.60%	36.40%	100.00%
Lost	Count	49	17	66
	% within True_Retention	74.20%	25.80%	100.00%
Total	Count	194	100	294
	% within True_Retention	66.00%	34.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.108; Likelihood Ratio 0.102

Analysis of quality of data recording and alcohol consumption

It is revealed in table 4.29 below that 37.7% of the patients enrolled in ePMS with good records drink alcohol and 29.10% with poor records also drink. Additionally, 70.90% of those with poor records and 62.30% of those with good quality records are not at risk due to alcohol consumption. Having poor or good records is not significantly associated, since the Pearson Chi-Square test (2.372) and a Likelihood ratio (2.390) shows a p-value of 0.124 and 0.122 respectively, which is >0.05 threshold. Therefore, the researcher failed to reject the null hypothesis of the quality of records that are associated with the risk of being exposed to alcohol consumption.

Table 4.29: Data recording and alcohol consumption

Data_Record		Alcohol consumption		Total
		Don't drink Alcohol	Drink Alcohol	
Poor records	Count	90	37	127
	% within Data_Record	70.90%	29.10%	100.00%
Good Records	Count	104	63	167
	% within Data_Record	62.30%	37.70%	100.00%
Total	Count	194	100	294
	% within Data_Record	66.00%	34.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.124; Likelihood Ratio 0.122

Analysis of quality of data recording, active status, and alcohol consumption (broad) risk

In table 4.30, it is indicated that 38.20% of the patients take alcohol, maintain an active status, and have good quality records compared to 22.10% of those who are presented with poor quality records. Furthermore, 77.90% of the patients with poorly managed records do not drink alcohol, while 61.80% have good quality records within the same cohort. The Pearson Chi-Square test (6.622) and the Likelihood ratio test (6.959) shows a p-value of 0.010 and 0.008, respectively. The researcher concluded that there is a significant association between poor data recording, being active in ePMS, and alcohol consumption, which is above the threshold of <0.05 significance level.

Table 4.30: Data recording, active status, and alcohol consumption

Poor data recording_On_active		Alcohol consumption		Total
		Don't drink Alcohol	Drink Alcohol	
Good	Count	134	83	217
	% within Poor data_On_active	61.80%	38.20%	100.00%
Poor	Count	60	17	77
	% within Poor data_On_active	77.90%	22.10%	100.00%
Total	Count	194	100	294
	% within Poor data_On_active	66.00%	34.00%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.010; Likelihood Ratio 0.080

Below is a summary presenting the prevalence of know CVDs risk factors among PLHIV initiated on ART:

Table 4.31: Summary of association between variables

Summary of association between variables (chi squares)												
Independent variable	Dependent variable (X ²)						95 %CI					
	High Systolic Blood pressure		Overweight/ Obesity		Alcohol		Smoking		Poor data recording		True retention	
	Pearson Chi square	P-value	Pearson Chi square	P-value	Pearson Chi square	P-value	Pearson Chi square	P-value	Pearson Chi square	P-value	Pearson Chi square	P-value
Sex	(.504)	0.478	(.513)	0.474	(.752)	0.386	(2.810)	0.094	(1.227)	0.268	(1.232)	0.267
Age	(.727)	0.394	(5.557)	0.018	(.382)	0.536	(1.000)	0.317	(6.676)	0.010	(4.673)	0.031
Marital status	(15.606)	0.048	(.318)	0.573	(.014)	0.907	(.731)	0.392	(.008)	0.927	(.029)	0.865
Blood pressure	n/a	n/a	(32.042)	0.001	(1.686)	0.194	(2.241)	0.134	(80.830)	0.001	(16.737)	0.001
Overweight/ obesity	(164.911)	0.001	n/a	n/a	(1.467)	0.226	(.573)	0.449	(53.014)	0.001	(31.950)	0.001
Alcohol	(77.802)	0.001	(1.467)	0.001	n/a	n/a	(.096)	0.757	(2.372)	0.124	(2.585)	0.108
Smoking	(76.888)	0.001	(.573)	0.449	(.096)	0.757	n/a	n/a	(3.853)	0.050	(.648)	0.421
Poor Data recording	(80.830)	0.001	(53.014)	0.001	(2.372)	0.124	(3.853)	0.050	n/a	n/a	(13.303)	0.001
Follow-up days	1.428)	0.490	(1.665)	0.435	(2.559)	0.278	(6.227)	0.044	(46.191)	0.001	(19.489)	0.001
True retention	(16.737)	0.001	(31.950)	0.001	(2.585)	0.108	(.648)	0.421	(13.303)	0.001	n/a	n/a
Last ART status	4.333)	0.115	(1.849)	0.397	(6.713)	0.035	(1.706)	0.426	(105.885)	0.001	(87.754)	0.001

4.5.5.5 DISCUSSION ON THE ASSESSMENT OF HEALTH RISK FACTORS ASSOCIATED WITH CARDIOVASCULAR DISEASES AMONG PLHIV INITIATED ON ART

Several studies revealed similar trends in Africa and globally (108,141). This study's findings concurs with Bogorodskaya, Chow, and Triant who postulated that an increase in age is a critical determinant of traditional risk factors and the role it plays in relation to CVD events (175).

The outcome of the prevalence of health risk factors is discussed below.

Health risk factors of cardiovascular diseases (CVDs) among PLHIV

The study findings show that high blood pressure, obesity, smoking, and alcohol use are exceedingly prevalent among PLHIV as depicted in table 4.31 above. These findings are in line with WHO (2011) which claims that non-communicable diseases have common risk factors and are largely preventable by the reduction of their four main behavioural risk factors: tobacco use, harmful use of alcohol, unhealthy diet, and physical inactivity (110).

Gender is one of the critical socioeconomic determinants of health (30). Several studies have revealed that women are more vulnerable to the risk of obesity, heart diseases, and stroke compared to men (20,141). Additionally, the female gender (AOR 2.12; 95 % CI 1.45–3.11) was significantly and strongly associated with comorbidity risk by Magodoro, Esterhuizen, and Chivese in a facility-based study of comorbid non-communicable diseases among adults living with HIV infection in Zimbabwe in 2016. On the contrary, this study revealed that more males are affected by cardiovascular diseases than females.

This study's findings concurs with Bogorodskaya, Chow, and Triant who postulated that an increase in age is a critical determinant of traditional risk factors and the role it plays concerning CVD events (175). Furthermore, the study findings also revealed that 60.4% and 62% are

presented with stage 1 and 2 risks of high systolic blood pressure, respectively. It is also revealed that more males (56%) are at risk of elevated or optimal risk of high systolic blood pressure compared to females. Similar observations were made in studies conducted in South Africa and India, where more females were found to be disproportionately affected by NCDs compared to males (30). These findings are contrary to an Indian study conducted by Anish et al., which found that systolic blood pressure, fasting blood sugar, and low-density lipoprotein were significantly lower in women (108).

The current study found that 40.5% of the patients between the ages of 41-50 years who are enrolled in the ART programme are at risk of stage 2 systolic blood pressure. On the other hand, 39.4% and 32.3% of the patients between the age group 41-50 years have been classified as high risk and optimal risk for raised diastolic blood pressure, respectively.

The study established a significant association (p -value of 0.001) between anthropometric status (BMI) and raised systolic and diastolic blood pressure. These results concur with Ansbro et al., who found that obesity ($BMI > 30 \text{ kg/m}^2$) was the only risk factor that increased the odds of having an uncontrolled BP in hypertensive patients ($p=0.02$) after adjusting for age, gender, smoking status, alcohol use and HIV status (176).

In one study conducted by Crothers et al. in 2007, it was postulated that PLHIV is less likely to receive smoking cessation counselling from their HIV providers(177), yet counselling is a critical lifestyle modifier in the reduction of CVDs.

Currently in Namibia, from the total patients who are active on the system, 20% are at risk of elevated systolic blood pressure showed a great statistical significance (p -value of 0.001)

between alcohol use and smoking of tobacco products. The results of this study are contrary to several other studies which indicated that alcohol use and smoking did not increase the risk of uncontrolled BP (176). The government of the Republic of Namibia should intensify efforts of regulating tobacco smoking policies and curb the mushrooming of illegal shebeens to reduce alcohol consumption to control alcohol-related harm especially in informal settlements (22).

Furthermore, the study revealed that PLHIV initiated on ART programme and sampled for this study had a mean follow-up day of 75.52% with a relatively low number of visits per annum which is reflected at 3.45%. Similar studies conducted in Eswatini (42%) and Cameroon (22.7%) demonstrated a slightly higher rate of follow-up days with a 16.3% loss to follow-up rate of per annum (176). Tracing of those who are lost to follow-up is generally done by volunteers from TCE although no documented defaulter tracing schedule exists at these clinics.

With the current epidemiological transition of HIV and cardiovascular diseases, there is a need to advocate for systems that provide accurate information, and early screening with subsequent treatment for PLHIV initiated on ART in the Khomas region (13).

In conclusion, assessing health risk factors associated with cardiovascular diseases among PLHIV initiated on ART is critical for:

- enhancing the routine tracking of health outcomes of cardiovascular disease risk factors amongst people living with HIV.
- provision of integrated healthcare services to PLHIV which leads to better health outcomes.
- institutionalising integrated CVDs care to PLHIV at all levels of health service delivery.

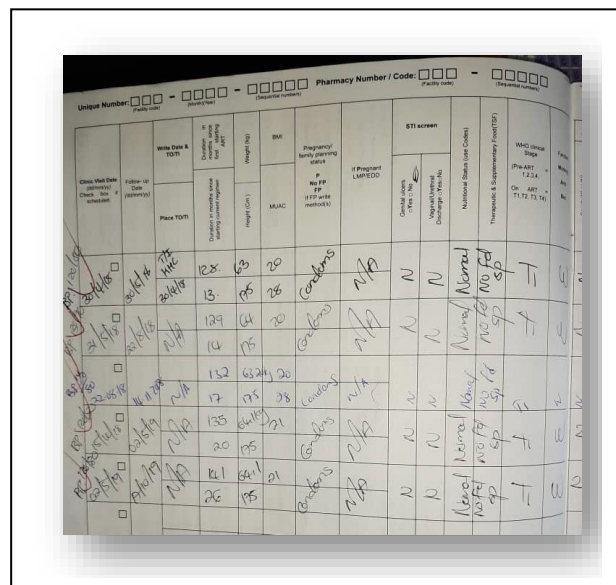
The next section deals with the patterns of CVDs risk factor data availability and completeness.

4.5.5 PATTERNS OF DATA AVAILABILITY AND COMPLETENESS OF RISK FACTOR DATA FOR CARDIOVASCULAR DISEASES ENROLLED ON THE ART PROGRAMME AT SELECTED HEALTH FACILITIES.

This study adopted a retrospective, cross-sectional, quantitative study design to determine health facilities' ability to collect and report quality data at the facility level and to identify gaps before developing the surveillance framework. The aims of the study were to: (i) determine the level of availability and completeness of data related to CVDs and their associated risk factors, and (ii) to identify strengths and gaps by reviewing health facility-based data obtained from individual patient care booklets at selected health facilities in the Khomas region. Lastly, the study (iii) made recommendations on corrective measures for strengthening the data management and reporting system and improving data quality.

The researcher used purposive sampling methods to extract data on the traditional risk factors for CVDs from the PCBs at Robert Mugabe, Otjomuise, Maxuilili, Donkerhoek, Groot Aub, Hakahana, and Wanaheda clinics. These risk factors were captured in PCBs and ePMS since the inception of the ART programme at the respective health facility (see Figure 4.1).

The extracted data was pair matched with the individual patient data in ePMS at the national level of the MoHSS. Several factors, such as how the availability of the



electronic patient monitoring system *Figure 4.4: Picture from MoHSS Patient Care Booklet 1* (ePMS) and the availability of the custodians of data at peripheral levels, influenced a site's likelihood of a clinic to be selected. Data on traditional risk factors for CVDs such as blood

pressure, height, weight, smoking, and alcohol usage were extracted from the Individual patient care booklets (PCBs) at the respective health facilities.

Quantitative data extracted from the PCBs were entered into an electronic database and analysed using the Statistical Package for Social Sciences (SPSS) version 25. This was aligned with the client’s cumulative data in the Antiretroviral Therapy Electronic Patient Monitoring System (ART ePMS) data set, which is managed and owned by the Ministry of Health and Social Services.

Completeness was represented as the percentage of no missing data elements or blank spaces found in the patient care booklet. A completeness score (depicted below) was developed to determine proportions of recordkeeping and missing data at each of the selected health facilities as illustrated below in table 4.32.

Table 4.32: Completeness Score

Indicator	Assessment criteria		Score
% Missing demographic and other systemic data	Demographics (Marital status, DOB, Age, St ART_Start_Year; Total Average of FP_Days; Total Average of visit_per year)	1. At Risk (inconsistent, incomplete or missing demographic data (Marital status, DOB, Age) and other systemic data (Start ART Year; Total Average of Follow-up days; Total Average of visits per year)	25%
		2. Not at Risk due to systemic challenges	75%

Descriptive statistics were used to categorise and describe continuous variables that were summarised using frequency distributions (bivariate or multivariate) and percentages for categorical variables and measures of central tendencies (mean, mode, distribution of

maximum and minimum values for continuous variables). Findings were presented in form of tables and graphs.

Generally, the quality of reported data is dependent on the underlying data management and reporting system; thus, more robust systems should produce better quality data. The results below provide an overview of data quality and the ability of data management systems to collect, manage, and report quality data.

The findings of the study are presented and discussed in the following sub-sections

- Section 4.5.5.1: Missing demographic and other systemic data
- Section 4.5.5.2: Poor data recording
- Section 4.5.5.3: True retention in ePMS

4.5.5.1 DEMOGRAPHIC AND OTHER SYSTEMIC DATA

Missing demographic and other systemic data in the PCBs and ePMS among PLHIV initiated on ART in the Khomas region are presented below.

Missing demographic and other systemic data

The findings in table 4.33 revealed that a total of 72.8 % of patients are at risk due to inconsistent, incomplete, or missing demographic data (marital status, DOB and age) and other systemic data (Start ART Year; Total Average of Follow-up days; Total Average of visits per year). Results show that 97.1% of data elements extracted from the client records were missing or incomplete in urban areas at a rating score of 25% compared to 2.9% in the rural areas. In a nutshell, 96.4% of these records rated at 75% are missing or incomplete in urban areas as opposed to 3.6% in rural areas. The Pearson Chi-Square test (2.204) and the Likelihood ratio (2.205) show a p-value of 0.204, which implies that the researcher failed to reject the null hypothesis.

Table 4.33: Missing demographic and other systemic data

%Missing * Urban/Rural Crosstabulation			Urban/Rural		Total
			Rural	Urban	
%Missing	25%	Count	11	374	385
		% within %Missing	2.9%	97.1%	100.0%
		% within Urban/Rural	57.9%	73.3%	72.8%
	75%	Count	8	136	144
		% within %Missing	5.6%	94.4%	100.0%
		% within Urban/Rural	42.1%	26.7%	27.2%
Total	Count		19	510	529
	% within %Missing		3.6%	96.4%	100.0%
	% within Urban/Rural		100.0%	100.0%	100.0%
	<i>Sig. 2-sided: Pearson Chi-Square 0.138; Likelihood Ratio 0.155</i>				

4.5.5.2 QUALITY OF DATA RECORDED

The association between average visits per year and poor data recording and active status, last ART status, and true retention among PLHIV initiated on ART in the Khomas region are presented below.

Analysis of average visits per year and poor data recording and active status

The results show that of those patients who have an average of 1-3 visits per year, 38.00% are active yet have their records poorly managed at the clinic as indicated in table 4.34 below. A total of 45.50% of the patients with 6-7 visit days per year are also presented with poor records management. However, 62.00% of those with properly managed data had at least 1-3 days visit per year compared to 79.20% who visited the health facility at least 4-5 days per year. Furthermore, 54.50% of patients who visited the health facility at least 6-7 days per year had good quality records. The Pearson Chi-Square test (19.907) and the Likelihood ratio (20.472) both show a p-value of 0.001. Therefore, the researcher concluded with 99.99% confidence

that there is a significant association between average visits per year, quality of data recorded, and the active status of the patient.

Table 4.34: Quality of data recorded, active status of patients, and average visits per year.

Visit_per year		Poor data recording_On_active status		Total
		Good	Poor	
Day1 to 3	Count	176	108	284
	% within Vist_per year	62.00%	38.00%	100.00%
Day 4 to 5	Count	168	44	212
	% within Vist_per year	79.20%	20.80%	100.00%
Day 6 to 7	Count	18	15	33
	% within Vist_per year	54.50%	45.50%	100.00%
Total	Count	362	167	529
	% within Vist_per year	68.40%	31.60%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

Analysis of quality of data recorded and last ART status.

The findings of the study show that an alarming number of 53.80% of patients whose records are poorly recorded and managed while active on ePMS are lost to follow-up. It is further revealed that 15.00% of those still actively on treatment have poorly managed records, as indicated in table 4.35. However, 85.00% of those who are always on medication and 46.20% of those lost to follow-up have properly managed records. The Pearson Chi-Square test (105.885) and the Likelihood ratio (106.165) both show a p-value of 0.001, which implies that the researcher rejects the null hypothesis. Therefore, the researcher concluded with 99.99% confidence that poor data recording is significantly associated with the last ART status risk of the patient.

Table 4.35: Quality of data recorded and last ART status.

Last ART Status		Quality of data recorded <u>On active</u>		Total
		Good	Poor	
Patient on pre ART	Count	17	34	51
	% within Last ART Status	33.30%	66.70%	100.00%
Patient lost to follow	Count	73	85	158
	% within Last ART Status	46.20%	53.80%	100.00%
Patient on treatment	Count	272	48	320
	% within Last ART Status	85.00%	15.00%	100.00%
Total	Count	362	167	529
	% within Last ART Status	68.40%	31.60%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

4.5.5.3 TRUE RETENTION IN ePMS

The association between true retention and average follow-up days (broad) risk per year, last ART status, and poor data recording (broad) risk and among PLHIV initiated on ART in the Khomas region is presented below.

Analysis of quality of data recorded and true retention.

The findings of the study show that a total of 52.90% of patients whose records are poorly recorded are indicated as lost to follow-up compared to 22.70% who are still active in the system although their records are poorly managed as indicated in table 4.36 below. Similar to the previous finding, both the Pearson Chi-Square test (46.191) and Likelihood ratio (44.494) show a p-value of 0.001, which implies that the researcher rejects the null hypothesis. Therefore, the researcher concluded with 99.99% confidence that poor data recording is significantly associated with true retention together with poor records management.

Table 4.36: Quality of data recorded and true retention.

	True_Retention	Poor data_On_active		Total
		Good	Poor	
Active	Count	289	85	374
	% within True_Retention	77.30%	22.70%	100.00%
Lost	Count	73	82	155
	% within True_Retention	47.10%	52.90%	100.00%
Total	Count	362	167	529
	% within True_Retention	68.40%	31.60%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

Analysis of true retention and average follow-up days risk

It is revealed that 46.20% of patients who are lost for 30 days and below were not adequately retained in ePMS and therefore at risk. Furthermore, 78.20% of the patients who have an average of Days of 61 and above are still active on the system, as revealed in table 4.37 below. The Pearson Chi-Square test (19.489) and the Likelihood ratio (19.203) both show a p-value of 0.001, which implies that the researcher rejects the null hypothesis. Therefore, the researcher concluded with 99.99% confidence that there is a significant association between a client retained in ePMS and average follow-up days.

Table 4.37: True Retention and average follow-up days

	FP_Days	True_Retention		Total
		Active	Lost	
Days 30 and below	Count	28	24	52
	% within FP_Days	53.80%	46.20%	100.00%
Days 31 to 60	Count	117	67	184
	% within FP_Days	63.60%	36.40%	100.00%
Days 61 and above	Count	229	64	293
	% within FP_Days	78.20%	21.80%	100.00%
Total	Count	374	155	529
	% within FP_Days	70.70%	29.30%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

Analysis of true retention and last ART status (broad) risk

The findings revealed that 85% of the patients who are on treatment are still active as per their last ART status, while 15% are lost at likely at risk as depicted in table 4.38 below. Since both the Pearson Chi-Square test (87.754) and the Likelihood ratio (86.320) show a p-value of 0.001, it implies that the researcher rejects the null hypothesis. Therefore, the researcher concluded with 99.99% confidence that there is a significant association between true retention and the last ART status of a patient.

Table 4.38: True Retention and last ART status

Last ART Status		True_Retention		Total
		Active	Lost	
Patient on pre ART	Count	17	34	51
	% within Last ART Status	33.30%	66.70%	100.00%
Patient lost to follow	Count	85	73	158
	% within Last ART Status	53.80%	46.20%	100.00%
Patient on treatment	Count	272	48	320
	% within Last ART Status	85.00%	15.00%	100.00%
Total	Count	374	155	529
	% within Last ART Status	70.70%	29.30%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

Analysis of true retention and quality of data recorded(broad) risk

The study findings show in table 4.39 below that 82.10% of active clients have their records poorly managed, of which 17.90% are indicated as lost. Another 66.10% are presented with an active status and have their records well maintained. However, 33.90% of patients with good records are reportedly lost from ePMS. The Pearson Chi-Square test (13.303) and Likelihood ratio (14.157) show a p-value of 0.001, which implies that the researcher rejects the null

hypothesis. Therefore, the researcher concluded with 99.99% confidence that there is a significant association between true retention and the quality of data recording practices.

Table 4.39: True Retention and quality of data recorded.

Data_Record		True_Retention		Total
		Active	Lost	
Poor records	Count	124	27	151
	% within Data_Record	82.10%	17.90%	100.00%
Good Records	Count	250	128	378
	% within Data_Record	66.10%	33.90%	100.00%
Total	Count	374	155	529
	% within Data_Record	70.70%	29.30%	100.00%

Sig. 2-sided: Pearson Chi-Square 0.001; Likelihood Ratio 0.001

4.5.5.4 DISCUSSIONS ON THE PATTERNS OF DATA AVAILABILITY AND COMPLETENESS OF RISK FACTOR DATA FOR CARDIOVASCULAR DISEASES ENROLLED ON THE ART PROGRAMME.

Ensuring data quality remains a complex problem in institutions dealing with a wide variety of information sources, systems, and users. The study found that designated staff are responsible for taking parameters from all PLHIV visiting health facilities for either initiation of ART or follow-up treatment at the respective health facilities. Task shifting was widely practised among all health workers. It was also found that reliable paper-based systems are still in place as it was confirmed by the respondents during the individual interviews. However, these systems ought to be aligned with interoperable electronic systems. Data are reported every month, but priority is given to specific diseases such as childhood illnesses, hepatitis, and other infectious diseases.

The researcher concurs that complete data is essential in ensuring that targeted health services are provided to PLHIV. The findings of this study are consistent with Botsis, Hartvigsen,

Chen, and Weng who postulated that completeness, consistency, and accuracy are some of the critical criteria for examining data quality issues (178). Other studies also adopted completeness as a criterion to measure data quality in their studies and all showed some level of incompleteness (179,180). The survey conducted by Bradshaw, Steyn, Levitt, and Nojilana reiterates that there is a need to improve the completeness of death registration and the quality of the cause of death information (92). In two other Ghanaian studies, it was revealed that data completeness, provision of feedback, and advocacy for public health intervention needs strengthening (109,110). Admittedly, findings from the qualitative part of this study have shown that the feedback on reports that are submitted is sporadic. Therefore, there is a need to strengthen the presentation of feedback.

4.5.6 GAPS ANALYSIS

This study identified gaps that merit the development of a surveillance framework to ensure routine tracking and predicting subsequent health outcomes (data collection, data aggregation, data analysis, reporting, and data quality) of cardiovascular diseases amongst PLHIV initiated on ART (as outlined in figure 4.5). The gaps that are discussed below have the potential of compromising the quality of data from peripheral, district, regional up to the national level.



Figure 4.5: Gaps identified in the management of CVDs risk factors.

Screening, capturing, and aggregation of risk factors of CVDs.

As indicated earlier in the report through the qualitative findings and confirmed by the quantitative results, commonly found risk factors of CVDs data were routinely captured in the PCBs for each PLHIV but these data elements are not collated for further analysis. In addition, the study also revealed that data recording for CVDs risk factors is somewhat fragmented and not harmonised among facilities in the Khomas region. As a result, decisions for alternative health service delivery for PLHIV is compromised. Notwithstanding, well-known inconsistencies in terms of CVDs risk factor data capturing in ePMS have led to each clinic adopting their own informal ways of recording these data elements in the Khomas region. This is evident from the qualitative findings as respondents reported that parameters such as BMI and others taken during follow up visits were not entered into the ePMS at the respective facilities. It was further reported that some facilities were still using the paper-based system. Furthermore, it was reported that not all paper-based data collected and captured made its way to ePMS. Such casual decisions could be attributed to a lack of standardised data capturing tools. Evidently, the study findings revealed that despite efforts of improving health outcomes of PLHIV, data quality, and recordkeeping in terms of availability and completeness remain unsatisfactory.

Consequently, lack of standardised or harmonised data collection and analysis efforts for CVDs risk factor data at the health facility level are some of the critical drawbacks in ensuring integrated routine measuring of CVDs health outcomes for PLHIV initiated on ART. This study found a significant association (Pearson Chi-Square p-value <0.001) between average patient visits per year and poor data recording of risk factors and active status of an individual patient captured in ePMS. Furthermore, significant association (Pearson Chi-Square p-value <0.001) was also found between the accuracy of data recording and anthropometric

indicators, poor data recording and retention of the patient in ePMS as well as the quality of data recorded and high blood pressure. Although there is evidence of increased risks of CVDs among PLHIV initiated on ART, the patterns and trends of HIV/AIDS and CVDs are not measured indicatively.

Data analysis, reporting, and feedback

The researcher established that weekly and monthly reporting is happening but only on priority indicators. However, this study found that there are no standardised procedures in place to provide feedback on reporting quality and subsequent use of such data. There is a need for more detailed analysis and bi-directional input of data that is routinely collected. Based on this finding the study proposes a robust feedback mechanism to circumvent the identified data quality issues for priority indicators. Such a feedback mechanism may include quarterly data review sessions that adopt an action-oriented approach whereby findings will be discussed, best practices are shared, and challenges pertaining to data quality issues are addressed in the different levels of data consolidation, synthesis, and use. Through such concerted efforts, the Ministry of Health and Social Services will bridge the knowledge gap that exists regarding the epidemiological transmission and multimorbidity of CVDs among PLHIV initiated on ART. The notion of knowledge gap is admitted by Magodoro, Esterhuizen, and Chivese who found in their study conducted in Zimbabwe in 2016, that there exists huge knowledge gaps in terms of the epidemiology, diagnosis thresholds, and optimal clinical management strategies of comorbid NCDs in HIV infection in the LMIC context(9). Similarly, the qualitative findings in this study also indicated that there is a shift in the priority of HIV management. The focus is more on IPT, PrEP, and TB, therefore, there is less attention given to CVDs risk factors.

Monitoring of CVDs risk factor data

Poor monitoring of risk factor data was identified by the lack of recording/capturing of commonly found risk factors for CVDs by using the completeness score. Multiple blank spaces in the PCBs where specific risk factors were supposed to be recorded to determine data availability and completeness were a barrier to true retention on ePMS. The researcher focussed on the actual data captured which denoted inadequate monitoring. The study also found that indicators for specific CVDs were not all-inclusive or operationally defined. The lack of evidence on the availability of formal and operational indicator definitions as well as harmonised reporting requirements for CVDs at all levels of the reporting system were identified as some of the gaps that compromise the quality of CVDs data amongst PLHIV initiated on ART. Given these challenges, the researcher developed a robust surveillance framework with specific characteristics and possible data sources to circumvent issues of poor data quality (see Chapter 6). This innovative idea might reduce the incidence of incompleteness, inconsistency, and inaccuracy of data at the health facility level. Lastly, the researcher recommends the increased frequency of data quality assessments, of data collected to determine health risk factors for CVDs.

Integration of CVDs into the HIV program

The ePMS guidelines provide enough information regarding the reporting processes for ART initiation, which helps ensure sustainability for patient-specific data that is captured and recorded into the PCBs. However, guidelines for measuring health outcomes for CVDs risk factors are neither standardised nor streamlined. For the system to integrate quickly, concerted efforts should be introduced to encourage the interoperability of information systems from the lowest level of service delivery. Involvement and active participation of the custodians of data is advocated for especially when amendments are recommended to existing systems. This

practice encourages ownership over data at the appropriate levels of service delivery. For example, as soon as the patient enters the health facility, every piece of data element becomes a critical progress marker. Therefore, the process of data collection, entry, collation, analysis, reporting, and use should be user-friendly and explicit for all the cadres in the health fraternity.

4.6 TRIANGULATION OF THE FINDINGS

The main findings of the qualitative study informed the quantitative data collection process. Both qualitative and quantitative results were merged to inform the development of the conceptual framework in the next chapter as well as the surveillance framework. The findings emanating from this study confirmed the researcher's concern about the lack of a surveillance framework to enhance the tracking of CVDs risk factors among PLHIV initiated on ART.

The outcome of the study resulted in the development of the proposed surveillance framework to ensure sound data quality management practices, predict the risk of CVDs and facilitate the continuum of health care delivery (94) to PLHIV initiated on ART in the Khomas region. Consequently, these efforts were most likely to contribute to the re-directing of policies, strategies, and service structures to include comprehensive healthcare to PLHIV, but also suffering from one or more chronic health conditions (67). The summary of the findings, gaps identified, central concepts, conclusions, and modalities of addressing the identified issues are summarised in table 4.40 below:

Table 4.40: Summary of the study findings, gaps identified, conclusions, and central concepts.

Qualitative findings	Quantitative findings	Gaps identified	Conclusion	Concepts developed
<p>Health workers perceptions</p> <ul style="list-style-type: none"> Lack of concerted/fragmented surveillance and monitoring efforts to track and link CVDs risk factors collected to PLHIV for individual follow-up care Inconsistent handling and managing of CVDs and its risk factors. Lack of consolidated data on CVDs risk factors and progress made in tackling them with tangible health outcomes. Insufficient feedback and usage of data to generate evidence-based information to reduce CVDs among PLHIV. Lack of an integrated system that encourages regular, institutionalised feedback on CVDs and its risk factors for subsequent interventions among PLHIV initiated on ART Lack of standardised efforts and links between information provided on CVDs risk factors by health workers and subsequent health interventions. Inadequate data collection due to parallel systems with no interoperability. Inadequate human and material resources Lack of standardised/institutionalised strategies, policies, and guidelines to facilitate regular integrated CVDs risk factor surveillance and M&E among PLHIV. Lack of knowledge of the existence of the national strategy on NCDs. 	<p>CVDs Risks factors extracted</p> <p>A significant association between CVDs risk factors and PLHIV were initiated on ART.</p> <ul style="list-style-type: none"> Anthropometric indicators and risk of systolic and diastolic blood pressure Alcohol use and High Systolic Blood Pressure Risk Smoking habits and Raised Systolic and diastolic Blood Pressure Risk Patient Retention and High Blood Pressure Risk <p>Patterns of data identified</p> <p>A significant association between systemic indicators and incomplete patterns CVDs risk factor data patterns among PLHIV initiated on ART</p> <ul style="list-style-type: none"> Data recording and anthropometric indicators; visits per year; last ART status risk; patient retention; follow-up days. Patient retention and anthropometric indicators risk Patient Retention and High Blood Pressure Risk Quality of Data recording and high Blood Pressure Risk 	<p>Inconsistent screening, capturing, and aggregation of risk factors of CVDs.</p> <p>Sporadic data analysis, reporting, and feedback.</p> <p>Inconsistent feedback on CVDs risk factors.</p> <p>Inadequate data use for decision making.</p> <p>Lack of integration of CVDs into the HIV programme.</p> <p>Insufficient data use for improved health outcomes.</p> <p>Lack of capacity to enhance the integration of CVDs into HIV Inadequate strategies, policies, and guidelines.</p> <p>Missing and incomplete CVDs risk factor data.</p> <p>Lack of tracking of risk factor data using a robust system.</p>	<p>Lack of standardised or harmonised data collection and analysis efforts for CVDs risk factor data at the health facility level to ensure integrated routine measuring of CVDs health outcomes for PLHIV.</p> <p>High prevalence of health risk factors such as high blood pressure, obesity, smoking, and alcohol use among PLHIV.</p> <p>Missing and incomplete data that has a significant effect on accurate surveillance, monitoring, and evaluation of cardiovascular diseases among PLHIV.</p>	<p>The following gaps identified from the study findings emerged as central concepts that informed the development of the surveillance framework:</p> <ul style="list-style-type: none"> Sound data management practices Enabling environment Evidenced based health outcomes

The major finding of this study garnered from the qualitative interviews revealed that all the parameters taken from the client are recorded in the patient care booklet (PCB) as elucidated below by one respondent:

“The patient care booklet is used to inform and guides information that is needed in terms of patient care, and this information is afterwards captured into the book and the system called ePMS”. (P2)

However, during the data extraction exercise, it was revealed that not all parameters of patients are captured or recorded in the PCB and subsequently in the ePMS.

The pie-charts below provides a summary of the magnitude of missing values in ePMS. In figure 4.6 it is revealed that 73.72% of the cases were presented with missing data, while 41.18 % of the variables were incomplete.

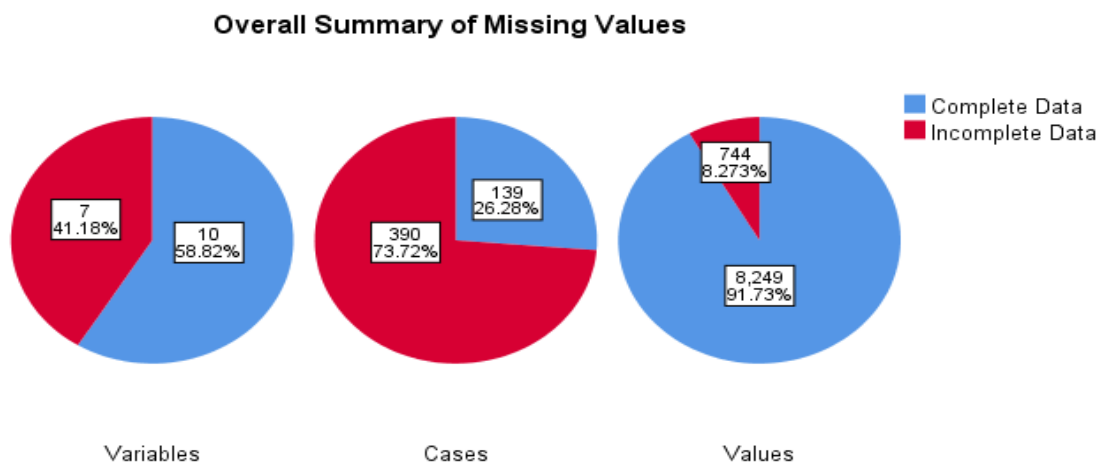


Figure 4.6: Overall summary of missing values

The missing value patterns were examined by looking at the pattern missingness of data elements, especially in terms of its availability and completeness in the PCBs and ePMS. The missing value pattern chart shows that at least 44.0% of missing values were detected for smoking and alcohol consumption, and 33% of those at risk of increased BMI. A lower concentration is observed in the last ART status (0.8%). The amount of missingness of critical

data elements supported the development of the surveillance framework Non-missing variables are mostly observed in sex, age, and average follow-up days as depicted in figure 4.7.

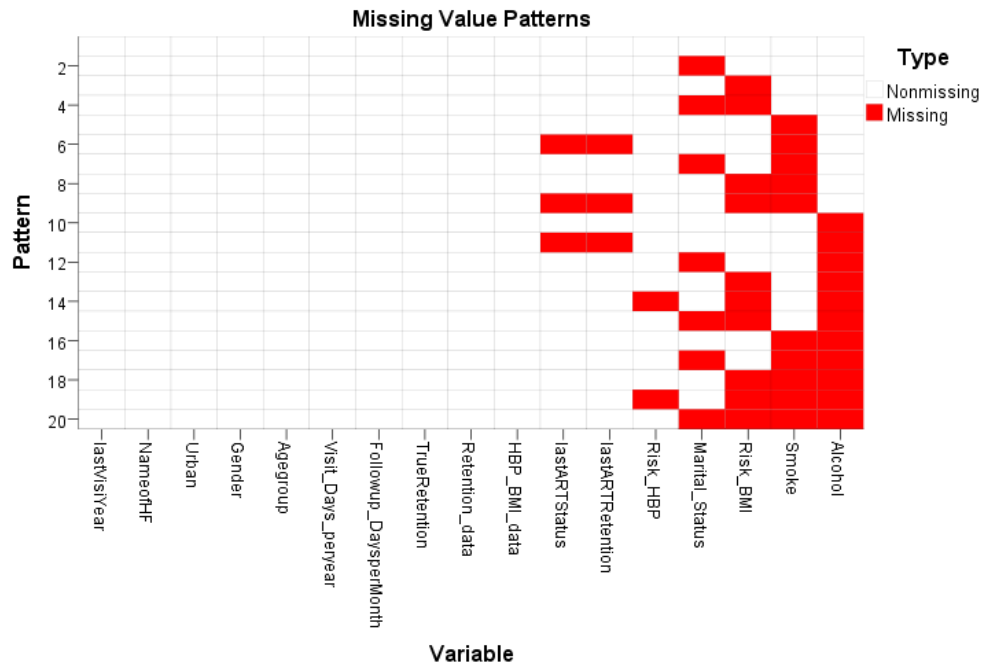


Figure 4.7 Missing Value Patterns

Some qualitative findings revealed that there is a general lack of standardised efforts and links between information provided on CVDs risk factors by health workers and subsequent health interventions. Some of the respondents remarked the following:

“We don’t monitor clients who are obese although the parameters are taken”.(P2)

“...we will probably tell the client your BP is high or sometimes to look at the diet...but honestly speaking there is no standardised way of doing it”. (P11)

“Vital signs are always done, but you know we don’t do it to monitor cardiovascular diseases. That’s why I think these things should be standardised”.(P11)

The quantitative findings confirmed the abovementioned concerns by healthcare workers. These findings concluded that there are significant associations found between the following variables (p-value=0.001):

- Anthropometric indicators (overweight/obesity) and risk of systolic and diastolic blood pressure

- Alcohol use and High Systolic Blood Pressure Risk
- Smoking habits and Raised Systolic and diastolic Blood Pressure Risk
- Quality of Data recording (Broad) and high Blood Pressure Risk
- True retention and anthropometric indicators (broad) risk
- Data recording and anthropometric indicators (broad) risk
- Poor data recording and visits per year (broad) risk
- Poor data recording and last ART status (broad) risk
- Poor data recording and True retention (broad) risk
- True Retention and follow-up days (broad) risk
- True Retention and last ART status (broad) risk
- True Retention and poor data recording (broad) risk.

Such statistical significance compelled the researcher to develop a surveillance and monitoring framework to circumvent current challenges of incomplete data and lack of utilisation of CVDs risk factors among PLHIV initiated on ART.

In table 4.41 below presents the prevalence of known CVDs risk factors with hypertension as the dependent variable among PHIV initiated on ART.

Table 4.41 Prevalence of CVDs risk factors among PLHIV initiated on ART (ODDS ratio)

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
	Marital Status	1.116	.549	4.139	1	.042	3.053	1.042	8.947
	Sex	.034	.249	.018	1	.892	1.034	.635	1.685
	Anthrom_indic	.778	.444	3.066	1	.080	2.178	.911	5.204
	At_Risk_Smoke	.667	.599	1.239	1	.266	1.948	.602	6.297
	At_Risk_Alcoh(1)	.335	.326	1.059	1	.303	1.398	.738	2.647
	Client_Reten_ePM S(1)	.129	.344	.141	1	.708	1.138	.579	2.235
	Constant	-3.218	.909	12.541	1	.000	.040		

a. Variable(s) entered on step 1: Marital Status, sex, Anthrom_indic, At_Risk_Smoke, At_Risk_Alcoh, Client_Reten_ePMS.

4.7 SUMMARY

This chapter provided a clear picture of the data management practices in the Khomas region. It is evident that health care workers are working around the clock to ensure the continuum of care to all PLHIV. However, efforts to improve data quality and recordkeeping in terms of availability and completeness remain unsatisfactory. Lack of standardised or harmonised data collection and analysis efforts for CVDs risk factor data at the health facility level are some of the critical drawbacks in ensuring integrated routine measuring of CVDs health outcomes for PLHIV. The development of the conceptual framework will be discussed in the next chapter.

CHAPTER 5: CONCEPTUAL FRAMEWORK FOR A SURVEILLANCE FRAMEWORK

5.1 INTRODUCTION

The findings for the study were presented and discussed in the preceding chapter. This chapter encapsulates Phase 2 of the study which identifies, defines, and conceptualises empirical findings garnered from the existing literature on surveillance of chronic health conditions and results obtained from the data analysis. These findings culminated in the development of the conceptual framework and the logical approach followed in constructing the intervening variables.

A conceptual framework is viewed as a visual representation linking all the research elements and outcomes based on the study's major theoretical tenets (181). Maxwell argues that such a framework is not readily found but constructed from different borrowed pieces with the aim of 'justifying' the research both substantively and methodologically (151). Miles, Huberman, and Saldaña further define a conceptual framework as a graphical depiction of the 'main things to be studied and the presumed relationships among them' (. p20) (152). In addition, Burns and Grove's definition succinctly captures the essence of a conceptual framework, defining it as 'an abstract, logical structure of meaning that guides the development of the study and enables the researcher to link the findings to the existing body of knowledge' (168). Thus, a conceptual framework is a visual guide consisting of a set of concepts that were deduced from the study findings.

5.2 CONCEPTS DEVELOPMENT

Following, the process of data collection, analysis, and interpretation, a detailed examination, clarification, and analysis of the various concepts was done. This study modified and utilised Schwartz and Kim's hybrid model of concept development (169,170) which consist of the following three interconnected phases depicted in figure 5.1 below:

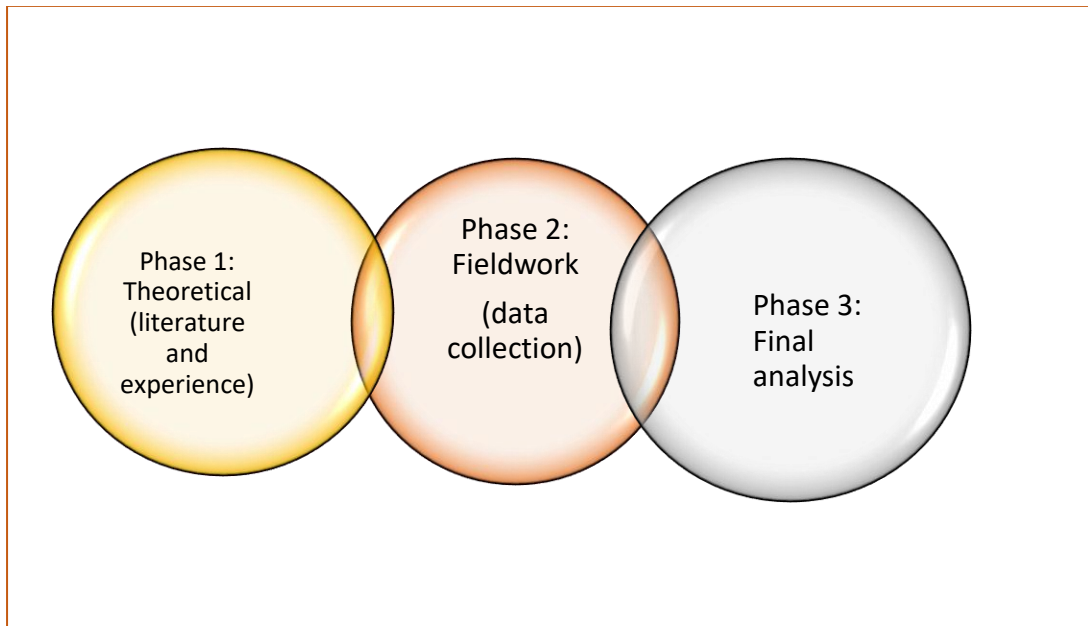


Figure 5.1: Major components of the Hybrid Model of concept development (Schwartz and Kim)

During the first phase, a detailed literature review was conducted to gain an understanding of the various theoretical underpinnings, different views of scholars and empirical research were critically reviewed to gain a better understanding of surveillance, monitoring, CVDs, PLHIV initiated on ART and health systems strengthening efforts as discussed in chapter 2. Data were collected sequentially through in-depth interviews with key healthcare informants to gain a better understanding of their perception of current data management practices regarding CVDs risk factors among PLHIV initiated on ART. Furthermore, the outcome of the in-depth interviews informed the quantitative extraction of CVDs risk factors from the PCBs and ePMS in the second phase. The process of data collection is discussed in chapter 3.

In the last phase, the analytical phase, findings from the theoretical and fieldwork phase were compared and analysed through thematic, summative content, and statistical analysis to define related concepts and develop a concept statement that is supported by both theoretical and empirical data as discussed in chapter 4. The process of concept analysis for **enabling environment**, sound **data management practices**, and **evidenced-based health outcomes**, were deduced from the study findings (see table 4.40) are discussed below.

5.3 PHASE 1: THEORETICAL PHASE

5.3.1 The process of searching for related concepts

Identifying related concepts contributed significantly to the validation of terms which might have had different meanings based on the field of study. Various dictionaries, topic-specific textbooks, and research publications were used to streamline both theoretical and operational definitions of the main concepts. A literature search was conducted on GoogleScholar, PubMed, Medline, with no date specified to define the 3 main concepts ‘**enabling environment**’, ‘**data quality management practices**’, and ‘**evidenced-based health outcomes**’ in the context of general health, NCDs, and HIV. Additionally, Medical Subject Headings (MeSH), free-text terms, and Boolean characters such as ‘AND’, ‘OR’, or ‘NOT’ were used to clarify the aforementioned terms.

5.3.2 Definition of the main concepts

This phase focus on developing a search for related and appropriate concepts(182)based on existing literature. The purpose was to seek an understanding about concepts and their application in theoretical contexts and promote consensus on interpretations of a phenomenon (11). Additionally, clarifying the meaning of an existing concept created a basis for operational

definitions simultaneously (7). A concept is, therefore, described as a “complex mental formulation of empirical experience” (183); a formal, rigorous process by which an abstract concept is explored, clarified, validated, defined, and differentiated from similar concepts to inform theory development and enhance communication (184,185); or “an activity where concepts belonging to a whole, their characteristics and relations they hold within systems of concepts are clarified and described (pg. 9) (182). According to Nuopponen, concepts may also be more field-specific ones (182) therefore the researcher opted to explore the two or three-word concepts (183). In a nutshell, concepts are therefore distinguished and delimited in the context of the specific field of interest.

5.3.2.1 The concept of enabling environment

The first central concept identified from the study findings is the ‘enabling environment’. The term ‘**enable**’ is defined in the Oxford English Dictionary as to ‘give one the means to do something; or to make something possible’. An **environment** a setting, or place where activities take place. Usually, an environment is organised to support its role in providing the necessary interventions or activities. The generic explanation of an enabling environment is that it is a **supporting structure** that is **warm, welcoming, and nurturing** and facilitates a **sense of belonging**; it provides a **safe space** where risks are minimised and gains maximised; it encourages **creativity** and bilateral **interaction** by all stakeholders. In addition, an enabling environment ensures that the intended **resources** are **used** for the intended audience without any discrimination. People, actors, or stakeholders are stimulated to take action to realise specific goals, and capacity building efforts are introduced to enable them to succeed. For example, both healthcare workers and PLHIV initiated on ART ought to be stewards of data and information about CVDs risk factors.

In the context of this study, an **enabling environment** refers to the health system environment that provides the overall climate and culture through its various decision-making systems, operating systems, and human resource practices that make demand-driven investments say Ferlie and Shortell (186). Furthermore, an enabling environment is perceived by Coonrod as a future where all citizens have the chance to lead a healthy and productive life. The concept enabling environment is effectively facilitated through creative and often organized efforts of people themselves. An **enabling environment** reflects the structural attributes known as **input measures** that will assist in enhancing the tracking of risk factors of CVDs among PLHIV initiated on ART. Convening attributes such as **stakeholders** (healthcare workers, PLHIV started on ART); **environment** (Primary Health care facilities); **material resources** (infrastructure and equipment); **services** (ART programme operating in an enabling environment); Health care system culture (organisational values, change management, mentoring and bi-directional referral) and **existing legislation** (multisectoral NCDs strategic plan, guidelines, and operational procedures) were all classified as contributing factors to ensuring a conducive environment for measuring health outcomes of PLHIV initiated on ART.

Attributes of enabling environment

Although, different scholars gave varied definitions of the concept enabling environment, **attributes** in the context of surveillance and public health were incorporated by the researcher. The WHO Health Systems Framework provides guidance on the necessary building blocks for every health system that facilitates an enabling environment for effective service delivery (55,75,187). These attributes are outlined in table 5.1 below.

Table 5.1: Attributes of enabling environment.

<p>Attributes of enabling environment in the health context</p>	<ul style="list-style-type: none"> • Attitudes and behaviours of health workers <ul style="list-style-type: none"> ✓ Accountability ✓ Professionalism ✓ Adherence to ethical considerations ✓ Non-discriminatory people-centred services delivery ✓ Promote safety and equality. • Necessary medical products and technologies are available at all levels of health service delivery. • Health information should be produced, analysed, disseminated, and used promptly. <ul style="list-style-type: none"> ✓ Accurate, reliable information that supports informed decision-making and interactions with health systems. • Health interventions must be: <ul style="list-style-type: none"> ✓ available and accessible at the time and place they are needed, ✓ acceptable, and, ✓ of high quality. • Budgetary allocations and financing strategies to achieve good health outcomes, universal health coverage, and cost-effectiveness of service delivery. • Policies, regulations, and operational incentives require:
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	<ul style="list-style-type: none"> ✓ Political will and commitment ✓ Collaboration and meaningful engagement of all stakeholders
<p>The key elements of an enabling environment are awareness, access, affordability, and accountability.</p>	

5.3.2.2 The concept of data quality management

One of the main concepts extracted from the findings of the study is ‘**data quality management**’ which is defined by Greiger as a “process that entails the establishment and deployment of roles, responsibilities, policies, and procedures concerning the acquisition, maintenance, dissemination, and disposition of data”(188). In order to deduce an operational definition for data quality management in the context of CVDs risk factors and PLHIV initiated on ART, three concepts data, data management, and data quality ought to be clarified.

Davies and LaCour define **datum** (singular) or **data** (plural) as items, observations, or raw facts (189) or texts (190). The Oxford Learners Dictionary explains **data** as facts or information that is examined and used to find out things or to make decisions. On the other hand, the Thesaurus enlisted **data** as quantities, characters, or symbols on which operations are performed by a computer, which may be stored and transmitted in the form of electrical signals and recorded on magnetic, optical, or mechanical recording media. Additionally, the Merriam Webster dictionary explains data as factual information (such as measurements or statistics) used as a basis for reasoning, discussion, or calculation.

Data management is referred to as standard operating procedures/ routines and actions put in place to track data flow and to ensure the data does not become corrupted at any stage (49,187).

Healthcare data management is the process of storing, protecting, and analysing data pulled from diverse sources (191). Data management is, therefore, summarised in three key words capture, store, and retrieve. Whatever data is captured ought to be stored in either paper-based or electronic systems. It is a common understanding that sound data management practices contribute significantly to the quality of data, especially completeness and accuracy.

In the third aspect, **data quality** is defined as the worth/accuracy of the information collected and focuses on ensuring that the process of data capturing, verifying, and analysis is of a high standard(192,193). Several scholars defined data quality as conformance to stringent requirements; knowing whether or not the target has been achieved; balancing two of the more common metrics of data such as **completeness** and **accuracy** (56,76,94,186,191,193–197). Data availability and completeness refer to the process of accessing accurate information in a specified location and the correct format (49,56,193,198). Improving the understanding, Mata et al., believes that completeness and quality of measurement are crucial for exposure and automation of predictor variables (80), and can be used reliably for predicting CVD risk for PLHIV initiated on ART through multivariate regression models and “machine learning”(80). For this study, data **availability** and **completeness** were used to determine CVDs risk factors among PLHIV initiated on ART.

Data quality management in this study is defined as the business processes that ensure the integrity of an organisation’s data during collection, application (including aggregation), warehousing, and analysis.

Attributes of data quality management

The definition of data quality management practices acknowledges contextual contributors to sound data quality, dissemination, and use for effective programme implementation. These contributors are summarised as the key stages of data quality management which plays a significant role in understanding the operational definition of data quality management practices. These stages as listed below ensure that the right data is made available to the right people at the right time at each of the following levels:

1. Data originates at the **source** level. At this stage, efforts are made to ensure that the right infrastructure is put in place so that all raw data elements are captured uncompromisingly.
2. During the **collection**, stage data is obtained from the source and transferred into the facility-based data collection tools (paper or electronic) from which it can be analysed and reported.
3. Data **collation** is a critical stage whereby raw data is aggregated and put into summarised formats.
4. The **analysis** of data is how the data relates to the specific objectives and targets. This stage also involves the review and manipulation of data before it is reported to the next level.
5. At the **reporting** stage is when the compilation of descriptive information and raw data is presented as useful knowledge. Healthcare workers and other stakeholders get an opportunity to view their progress, problems, difficulties encountered, successes and lessons learnt which resulted during the implementation of health-related activities.
6. The last stage which denotes the **usage** of data allows healthcare workers to make timely data-driven decisions.

Based on the abovementioned key principles, the following attributes were delineated for data quality management practices as summarised in table 5.2 below:

Table 5.2: Attributes of data quality management practices

<p>Attributes of data quality management practices in the health context</p>	<ul style="list-style-type: none"> • Data security and adherence to ethical considerations remain a key attribute. • Data should be stored in a system (paper-based or electronic). • Data systems should be simple to learn, convenient to operate because the users vary from beginner to sophisticated operators. • Data can be integrated and presented on demand. • Inputted data is reliable, renewable, current, and accurate. • Data should be easily disaggregated. • Integrated data quality management continuously maintains the trustworthiness of data. • Reveal opportunities to increase efficiency via evidence-based best practice. • Have the functions of statistical analysis and development prediction to various attribute data. • The ease with which data can be extracted for reporting purposes. • Routine types of data processing are fast and efficient.
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According to the American Health Information Management Association (AHIMA), the definition of data quality management comprises eight key principles namely accountability, transparency, integrity, protection, compliance, availability, retention, and disposition (199).

The suppositions of the HISSM model echoed similar dimensions of data quality such as accuracy, reliability, precision, completeness, timeliness, integrity, and confidentiality (200).

5.3.2.3 The concept of evidenced-based health outcomes

The third central concept identified was evidenced-based health outcomes. The concept of evidenced-based health outcomes has four distinct words such as **evidence**, **based**, **health**, and **outcomes** that are interrelated. These terms are clarified below. **Evidence** refers to data, facts, information, and knowledge which has been proved believed, or justified as true (2) on which decisions are based (3,4). The term-**based** is referred to by Chiwaula et al., as a foundation or the centre of all operations (3). Although there are many definitions of the term health, the researcher opted to zoom in on the following two most commonly used by WHO and the Oxford Dictionary. The latter defines **health** as “soundness of body or mind; that condition in which its functions are duly and efficiently discharged”. Consequently, the generic WHO definition of **health** which is a “state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (201) applies to the context of this study which in recent years has been amplified to include the ability to lead a ‘socially and economically productive life’ (201). On the other hand, the term **outcomes** relate to measures that reflect patient status that is particularly used to determine any health interventions to be implemented. An **outcome** could also be referred to as the result of a patient’s treatment in the clinical field.

In the context of this study, one would contemplate those critical decisions regarding the health of PLHIV initiated on ART ought not to be based on intuition or anecdotal information but rather on facts that are substantiated with science. Thus, **health outcomes** are changes in health that result from measures or specific health care investments, or interventions says the Canadian Institute of health information. Additionally, Sackett et al., is of the opinion that evidenced-based health care is better posited if it involves tracking down the best external evidence with which to answer our clinical questions (202).

The term evidenced-based practiced as admonished by Dr. Archie Cochrane in 1971 which focused predominantly on ensuring that the provision of health care is based on scientific evidence (203), played a significant role in deciphering the concept evidenced-based health outcomes. Several other authors expanded Dr. Cochrane's definition by including clinical judgment and patient preferences as part of the accurate continuum of healthcare interventions (202–204). **Evidenced-based health outcomes** are defined as a **tangible effect, consequence, or result** of a medical condition that directly affects the length or **quality** of a person's **life** (190). Evidenced-based health outcomes are further operationally defined as measuring health outcomes that improve the **longevity** and quality of life of PLHIV initiated on ART by identifying and introducing targeted interventions to avert the impact of cardiovascular diseases and other non-communicable diseases. Evidenced-based health outcomes at this level were therefore proposed in relation to critical integrated health system functions, such as (88,205–207):

- **Governance:** the alignment with existing regulatory mechanisms, creation of unified accountability frameworks, and integration of reporting complemented existing efforts of the Ministry of Health and Social Services. Underpinnings such as governance and leadership remain critical steppingstones to enhanced integration and comprehensive healthcare delivery to PLHIV. A multisectoral approach in the identification of CVDs

and subsequent interventions was considered by the researcher as a critical denominator in mounting an effective response to addressing multimorbidity among PLHIV.

- **Financing** functions for health facilities are handled as part of the regional and national programme budgeting processes and allocations of the Economising Committee of the Ministry of Health and Social Services on an annual basis. Therefore, the researcher could only make suggestions through the development of a costed M&E plan at this stage.
- **Planning** efforts were proposed by the researcher to needs assessment, priority setting, capacity planning, and resource allocation of health interventions focusing on CVDs risk reduction among PLHIV. These efforts ought to be integrated into health system planning functions which are part of the annual work planning process of the MoHSS. As indicated earlier, task shifting and work-skill mix have become a welcome innovation in most health facilities who participated in this study as revealed by the study findings.
- **Service delivery:** reflects the immediate intervening strategies to address mortality and morbidity of PLHIV due to CVDs. Continuum of care is advocated for thorough routine integration of health service delivery to PLHIV adopting a one-stop-approach. That way, issues of ‘missed opportunities’ due to inconsistent referral practices between different health facilities and bilateral feedback from higher levels in the reporting lines will be reduced.
- **Monitoring and Evaluation:** revolves around the entire process of information generation which includes processes such as collection, collation, analysis, reporting, and usage of health and health-related data from a variety of sources, as well as the creation and distribution of health information products (208). The concepts of data quality management place a significant role in this aspect.

- **Demand generation:** This aspect required an enabling environment for the introduction of integrated demand-driven interventions to manage CVDs risk factors, illness episodes, and multimorbidity among PLHIV initiated on ART. In line with the recent efforts of the Ministry of Health and Social Services to incorporate the WHO Essential Health Package for NCDs management as well as the launching of the National Strategy on NCDs in 2017, the researcher proposed joint approaches such as streamlined individual- and population-level health education and promotion interventions (Atun et al., 2010).

The above main concepts were deemed pivotal in explaining and organising the surveillance process (17) for cardiovascular diseases among PLHIV initiated on ART.

Attributes of evidenced-based health outcomes

In search of a contemporary definition of evidenced-based health outcomes, the researcher focussed on definitions for evidenced-based practice and evidenced-based medicine to summarise the attributes listed in Table 5.3 below. The aforementioned is defined by practice based on the best available evidence, patient preferences, and clinical judgement (203). The latter is defined by Sackett et al., as “the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients”(202).

Table 5.3 Attributes of evidenced-based health outcomes

Attributes of evidence-based health outcomes	<ul style="list-style-type: none"> • Acquisition of knowledge. • The best available evidence depicts the accuracy and precision of diagnosis and subsequent treatment of patients.
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	<ul style="list-style-type: none"> • Efficacy and safety of therapeutic, rehabilitative, and preventive regimens. • Tracking down the best external evidence with which to answer our clinical questions. • Follow-up health care to ensure a continuum of care for each patient seeking health services. • Regular bi-directional feedback. • Generation of theory derived, research-based information.
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5.4 PHASE 2: FIELDWORK PHASE

Emergent themes from the study findings revealed fragmented data management practices at targeted health facilities in the Khomas region. Health workers perceptions such as inconsistent screening, capturing, aggregation, analysis, reporting, and use of data of CVDs risk factors among PLHIV initiated on ART advised sound *data quality management practices* at these facilities as follows:

- Monitoring exposure of CVDs risk factors among PLHIV.
 - Lack of concerted surveillance efforts to track and link CVDs risk factors collected to PLHIV for individual follow-up care.
- Measuring health outcomes of CVDs risk factors among PLHIV.
 - Lack of consolidated data on CVDs risk factors and progress made in tackling them with tangible health outcomes.
- Handling or managing of risk factor data for CVDs.
 - Inconsistent handling and managing of CVDs and its risk factors.

- Lack of standardised efforts and links between information provided on CVDs risk factors by health workers and subsequent health interventions
- Utilisation of CVD data for decision making.
 - Lack of an integrated system that encourages regular, institutionalised feedback and use of CVDs and its risk factors for subsequent interventions among PLHIV.
 - Insufficient analysis and usage of data to generate evidence-based information to reduce CVDs among PLHIV.
- Health system response and capacity to manage CVDs among PLHIV.
 - Inadequate data collections/parallel systems with no interoperability of existing guidelines, policies, and strategies on the integration of clinical interventions for CVDs among PLHIV.

The lack of an integrated system that encourages regular, institutionalised feedback on CVDs and its risk factors that will facilitate subsequent interventions among PLHIV initiated on ART emphasised the need for *evidence-based health outcomes* as revealed by the following theme and sub-theme.

- Lack of standardised/institutionalised strategies, policies, and guidelines to facilitate regular integrated CVDs risk factors surveillance and M&E among PLHIV.
 - Lack of implementation of the national strategy on NCDs at the health facility level to speed up regular integrated CVDs risk factor surveillance amongst PLHIV.

As indicated in the discussion of the study findings in chapter 4, significant association (Pearson Chi-Square p -value <0.001) were found between various data elements. For example:

- average patient visits per year and poor data recording of risk factors and active status of an individual patient captured in ePMS.

- accuracy of data recording and anthropometric indicators,
- poor data recording and retention of the patient in ePMS , and
- quality of data recorded and high blood pressure.

5.5 PHASE 3: ANALYTICAL PHASE

This study revealed that sound **data quality management** practices ought to be implemented in a functional organisation/environment to measure CVDs health outcomes of PLHIV initiated on ART holistically. It is evident from the quantitative data extraction that the quality of data in terms of availability and completeness was heavily compromised (for example *significant associations were found between retention and missing data*). Therefore, assuring data quality will circumvent multiple challenges that can be avoided by advocating for **evidence-based health outcomes**. The use of high-quality data from a variety of sources ought to encourage evidence-based decision making. Missing, and incomplete CVDs risk factor data were identified as significant data quality issues in this study. Furthermore, the lack of capacity, insufficient structural attributes to enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART were identified as the main salient concerns under the concept of **enabling environment**.

The literature reviewed revealed that the tracking and linking of CVDs risk factors data for each individual in the PLHIV category, at the facility, district, regional and national levels that will expedite integrated health interventions and outcomes (48). A key feature in ensuring that quality data is managed is by conducting data audits which are regarded as the process of verifying the quality of reported aggregate data. Currently, data for PLHIV initiated on ART is captured and recorded in the PCBs as well as ePMS which is regarded as low-hanging fruits that could be used as an ideal springboard to ensure the prediction and tracking of CVDs risk factors among PLHIV initiated on ART. For example, lack of regular data quality checks and

audits; centralised data management and analysis tasks; lack of emphasis on the review of data for M&E purposes or programme decision-making, and limited or irregular dissemination of information (52,56,57). Champions of strategic information are required at all levels of reporting to circumvent data quality issues experienced at health facilities.

Through the identification and interrogation of central concepts such as enabling environment, sound data management practices, and evidenced-based health outcomes, *management of CVDs data practices among PLHIV initiated on ART* was finally formulated as the central statement which informed the conceptual thinking and the development of the mechanism.

5.6 DEVELOPMENT OF THE CONCEPTUAL FRAMEWORK

To overcome the scarcity of surveillance and use of CVDs risk factor data captured at the facility level, the study findings and the process of concept analysis, the development of the conceptual framework that can enhance the tracking of CVDs risk factors among PLHIV initiated on ART in Khomas region was structured. The theories are highlighted below:

- Five tenets of the Population Health Surveillance Theory (PHST) as proposed by El Allaki et al., namely trigger, problem formulation, surveillance planning, surveillance implementation, and information planning and audit(17); and,
- Three elements of the Avedis Donabedian's (1966) SPO model which are structure (resources), process (clinical activities), and outcome (the desired result of healthcare) (10,137,139).

The matrix below summarises the theory and framework which was found to be relevant and was incorporated into the development of a conceptual framework.

Table 5.4: Theories deemed appropriate to use for the conceptual reasoning map

Theory/Model	Rationale	Aspects of focal areas					Shortcomings or limitations
		A trigger or need	Problem formulation	Surveillance planning	Surveillance Implementation	Information communication and audit	
Population Health Surveillance Theory (PHST)	The PHST theory stipulates that surveillance is based on an epi-intelligence approach which is supplemented by a crude data gathering and presentation using an automated monitoring approach.						Existing data sources might not provide accurate information on a specific problem. Prediction of probable risk factors and subsequent diseases conditions are not regarded as priority
Avedis Donabedian's SPO Model	The Donabedian model postulates that focusing on structures and processes enhance the measurement of health outcomes that will improve quality health care.	Structure	Process	Outcomes			Establishing a relationship between structure, process, and outcome is a probability rather than a certainty.

The researcher's reasoning map in figure 5.2 represents the process followed by Allaki's PHST model to identify and formulate the need for tracking and predicting health outcomes of CVDs risks among PLHIV initiated on ART. For example, adequate resources contribute to an enabling environment in which CVDs risk factors are identified, streamlined, and ultimately used to measure outcomes of PLHIV initiated on ART. The whole process of surveillance planning, implementation, and sharing of information contributes to the development of a surveillance framework that enhances the tracking of CVDs risk factors among PLHIV initiated on ART, which is the ultimate purpose of this study.

The researchers reasoning map is depicted below in figure 5.2.

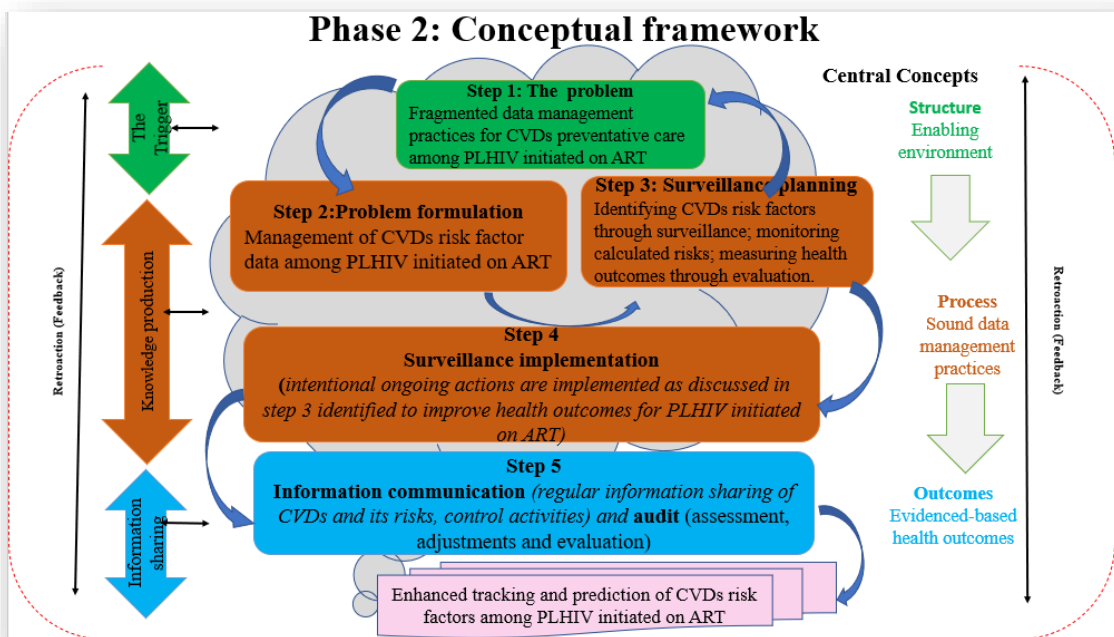


Figure 5.2 The researchers reasoning map (Mahalie, 2019)

The following steps were used to develop the conceptual framework for integrating CVDs data management practices into interventions for PLHIV:

- Step 1: The trigger or need.
- Step 2: Problem formulation
- Step 3: Surveillance plan
- Step 4: Surveillance plan implementation
- Step 5: Information communication and auditing

The abovementioned steps are discussed in detail below:

5.6.1 STEP 1: TRIGGER OR NEED IDENTIFICATION

In this study, the researcher placed the identification of the need in the context of causal presumed relationships, thus ensuring the establishment of the need for an integrated response

between the measurement of improved health outcomes of CVDs risk factors and subsequent health interventions for PLHIV initiated on ART. Reaching consensus on the identification and acknowledgement of an existing problem or need in this study was considered a critical parameter for the development of a surveillance and monitoring framework that will enhance tracking of CVDs risk factors among PLHIV initiated on ART.

El Allaki et al., reasons that three (3) pre-requisite elements are critical, namely, i) a **dissatisfaction**, ii) a need for **knowledge** and/or time-dependent information, and iii) some level of **motivation** to eliminate the dissatisfaction and meet the information need about the population health status (17), during the problem identification stage of a surveillance process.

The **dissatisfaction** arose after it was identified that PLHIV initiated on ART might be due to insufficient surveillance. Essentially, this means the focus is only on collecting antiretrovirals, whilst the measuring of CVDs health outcomes is neither mainstreamed nor institutionalised. Although health systems are facing many challenges in LMICs, effective integration and gradual assimilation have the possibility of circumventing problems such as inadequate and interoperable parallel data collection systems (17). Using the suppositions of the Population Health Surveillance Theory (PHST) as proposed by El Allaki, Bigras-Poulin, Michel, and Ravel (17), the researcher was prompted to accentuate dissatisfaction in three main concepts, namely *enabling environment, sound data quality management practices, and evidenced-based health outcomes* from the research findings after data analysis as indicated in table 4.41 in chapter 4.

After the dissatisfaction has been identified and labelled, the search for a need for **knowledge production** and/or **time-dependent information** becomes a reality as proposed by El Allaki et al., (17). **Knowledge** generation and **timely** sharing of information are critical in this step. By so doing, PLHIV initiated on ART gets an opportunity to make informed decisions for their

health outcomes about CVDs and its common risk factors. Once capacity is built for PLHIV initiated on ART, **motivation** is needed to eliminate the issues that cause dissatisfaction. **Motivation** is generally regarded as an essential gatekeeper for personal and professional growth. Subsequently, information on silent killers like cardiovascular diseases is not readily available to authorities, thus necessitating the introduction of demand-driven interventions that will circumvent the escalating number of PLHIV being discharged from health facilities without comprehensive clinical interventions.

In a nutshell, the researcher concurs with Atun et al., that addressing the problem of **fragmented data quality management practices for CVDs preventative care among PLHIV initiated on ART** ought to be expedited by introducing necessary interventions at the health facility level.

5.6.2 STEP 2: PROBLEM FORMULATION

El Allaki et al., advises that the problem formulation process must be clear, rigorous, and precise (17). On the other hand, Atun et al., postulates that the narratives around the characteristics and burden of a specific problem influence the urgency and speed with which an intervention is integrated into the general health system (34). In the second step, the actual problem is formulated, which is informed by a ‘formal and specific description of the dissatisfaction’, in collaboration with deliberations with relevant stakeholders. Furthermore, the formulation of the problem also included other elements such as identification of the health outcome measured; definition of the target population under surveillance which required monitoring; and analysis of the current situation over time, which informed the development of surveillance objectives.

This step maps the surveillance planning, which zooms in on pragmatism since the researcher was concerned with developing a practical application to track CVDs risks among PLHIV initiated on ART. This process is critical for not only disease control but also to adhere to international obligations such as the achievement of NCD targets set in the United Nation's Sustainable Development Goals and the Post-2015 Development Agenda (59).

The problem formulation step is summarised as follows:

- **Identification of the health outcome measured:** The health outcome to be measured in the context of this study denotes the introduction of sound data management practices that will enhance surveillance of CVDs risk factors tracking among PLHIV initiated on ART.
- **Definition of the target population under surveillance and which required monitoring analysis of the current situation over time:** The target population under surveillance was identified as PLHIV initiated on ART as well as the health care workers managing health data at different levels of reporting.
- **Development of surveillance objectives:** The following specific objectives were proposed for the surveillance of CVDs risk factors among PLHIV initiated on ART which is in line with the purpose of the study, the study objectives which respond to the overall study questions.
 - ✓ To enhance routine tracking of risk factors for cardiovascular diseases among PLHIV.
 - This objective responded to the first research question which focussed on gaining an understanding of the current practices of routine tracking of cardiovascular risk factors data collection, analysis, and reporting and use among people living with HIV (PLHIV) on ART.

- ✓ To promote the integration and utilisation of CVDs risk factor data in program planning and management useful for measuring health outcomes.
 - This surveillance objective responded to the research question on how CVDs risk factor data can be integrated into existing HIV care and monitoring platforms.
- ✓ To predict and direct sound data management processes (data storage, data quality, data processing, compilation, and dissemination) that are useful in measuring of CVDs health outcomes among PLHIV initiated on ART.
 - What surveillance framework can enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART?

The problem formulated based on the findings of the study relates to the problem of fragmented data quality management practices for CVDs preventative care among PLHIV initiated on ART.

5.6.3 STEP 3: SURVEILLANCE PLAN

Surveillance planning is defined as an ongoing process that provides a technical and logistical framework for making decisions concerning the expected results and the strategies available for solving the surveillance problem (17). Surveillance planning revolves around the entire process of information generation which includes processes such as collection, collation, analysis, reporting, and usage of health-related data from a variety of sources, as well as the creation and distribution of health information products (208). This step is thus, consistent with the objectives formulated in step 2.

In this study, the scope for the development of the framework was limited to the themes that emerged from the perceptions of health workers on the data management practices, CVDs risk factor data that was extracted from the PCBs and ePMS, and the identification and analysis of central concepts. These findings were useful for understanding integrated CVD-related

preventive care services to PLHIV initiated on ART. For this purpose, the multifaceted interactive reasoning of the Syndemic theory informed the surveillance planning, namely:

- to recognise possible biological interactions between two diseases which emphasised the concept of sound **data quality management practices**. Co-morbidity between HIV, being initiated on ART, and the development of common risk factors for CVDs demonstrates such interaction. Mendenhall et al., and other authors assert that these biological interactions occur as a result of common risk factors which could be genetic or environmental, and iatrogenically through biological effects of treatment on other physiological systems (3,124,209). The findings of this study and reviewed literature agree that CVDs and the prevalence of traditional risk factors have become one of the most prevalent chronic comorbidities for PLHIV enrolled in specific antiretrovirals (4,99–102). It was also revealed that such syndemics put an extra burden on health systems that are ill-prepared to manage the changing disease patterns (11,13,19,78,103). In this study, the researcher opined that co-occurring biological interactions and the prompt identification of CVDs risk factors are dependent on the institutionalisation of sound data management practices at the health facility level.
- to describe under what circumstances diseases, interact, and what can be done to intervene related to the **enabling environment**. The ability of the health system to screen, detect, and treat CVDs risks among PLHIV initiated on ART usually affects how multimorbid diseases interact. For example, delays in measuring CVDs health outcomes for PLHIV initiated on ART may result in delayed care-seeking, and thus diagnosis (3). The reviewed literature highlighted that poorly coordinated surveillance systems have the habit of addressing case-specific needs which subsequently result in a lack of timely data provision (87) whilst the qualitative findings revealed parallel systems and inadequate human and

material resources. This has the potential of extrapolating the syndemic suffering of individuals (3).

- to intervene in ways that address social and medical conditions that interact and promise to offset the burden of their interaction tied to the concept of **evidence-based health outcomes**. During this process, the researcher aimed at facilitating an integrated continuum of care to PLHIV initiated on ART. Through this effort, a surveillance framework that encourages early detection, control of CVDs, and integrated health care provision to PLHIV initiated on ART was proposed. Notwithstanding, Choi, as well as the study findings, revealed that health information systems are not always integrated with public health surveillance and prevention activities (87). High-quality data and comprehensive, integrated health services may lower incidences of chronic diseases in settings that encourage early detection and screening for metabolic disorders such as CVDs among those who routinely take antiretrovirals (20,31,117,210). Although MOHSS introduced integrated health service delivery, the integration of CVDs and HIV care services are traditionally marginalised within the health system. Therefore, this surveillance framework will enhance such integration in primary health care settings, which were identified by the researcher as the ideal springboard to be used.

Atun et al., are of the opinion that the number and nature of tools used to address a problem, and the degree of user engagement needed are critical in ensuring the achievement of improved health outcomes or risk reduction (34) and thus the drivers of success of the surveillance framework. External validation of the surveillance framework remains a critical factor in the success of implementing a framework.

The detailed surveillance plan and the guidance for operationalisation and implementation are discussed in chapters 6 and 7.

5.6.4 STEP 4: SURVEILLANCE IMPLEMENTATION WITHIN THE HEALTH SYSTEM

In this study, the aforementioned adoption process was planned to occur at the health facility level to roll it out to the district, regional and national levels in the Khomas region. It was confirmed through this study that unstructured and unmonitored clinical care and little information about morbidity or mortality (211) remain a challenge in most health facilities. In the context of this study, the underpinnings of an **enabling environment** such as good governance and leadership remain critical steppingstones in enhancing integrated and comprehensive healthcare delivery to PLHIV initiated on ART. Whatever data management practices are advocated for ought to speak to existing policies and standards that enhance the effective integration of CVDs into ART platforms (16,165,166). This emphasises the significance of capacity-building before and during any health intervention. In essence, deciphering the context, opportunities are plenty for the integration of sound **data quality management practices** useful for providing CVD-related preventive care services to PLHIV initiated on ART in the Khomas region. Atun et al., reiterates the fact that demonstrable synergies and benefits can be achieved by such integrated **evidence-based interventions** (78). Amidst challenges such as tight budgets, financial implications for the integrated surveillance system, the subsequent M&E framework is negligible as existing resources are used to enhance targeted, evidence-based CVDs outcomes for tracking among PLHIV (16,78).

With continuous political will and commitment, various stakeholders/champions contribute to collective efforts of ensuring evidence-based CVDs outcomes enhancing the tracking and quality improvement at the health facility level.

Based on the above reflections, El Allaki proposes that the implementation of surveillance efforts should be ongoing and includes tacit and explicit knowledge (17). The term **knowledge**

is defined by Stair et al., as the body of rules, guidelines, and procedures used to select, organise, and manipulate data to make it suitable for a specific task. Tacit knowledge refers to acquired 'know-how' which is not written down and quite difficult to articulate. Soft skills, values, personal experiences are typical examples of tacit knowledge. On the other hand, explicit knowledge is gained during formal training, and it is generally documented, such as policies, strategies, and guiding documents. The expectation is that health care workers and PLHIV initiated on ART is expected to possess both categories of knowledge in order to ensure continuous measuring of CVDs health outcomes. Noteworthy, the study findings revealed that these people possessed different perceptions of the benefits and risks related to the identification and integrated provision of care pertaining to CVDs among PLHIV initiated on ART as outlined in chapter 4.

5.6.5 STEP 5: INFORMATION SHARING AND AUDITING

The expectation is that knowledge gained on collective efforts of incorporating the WHO Health Systems Framework for NCD surveillance components such as (i) monitoring exposure (risk factors and determinants), (ii) outcomes (morbidity and disease-specific mortality), and (iii) health system response and capacity (187) is producing evidence-based CVDs health outcomes for PLHIV initiated on ART. By so doing, information needs are shared with relevant stakeholders about measurable health outcomes. Tracking these outcomes ought to be communicated regularly to maintain the motivation and the engagement of all stakeholders and decision-makers at various levels of implementation. Both qualitative and quantitative findings revealed that some CVDs risk factors are captured in the PCBs and ePMS. However, the missing pattern values revealed a higher concentration of missing data elements for alcohol, smoking, and body mass index at the health facility level. Proactive interventions as advocated for by Patel et al., warranted the development of the surveillance framework to predict the

possibility of being PLHIV initiated on ART being diagnosed with at least one of the cardiovascular diseases before the actual onset of the disease (79). Since robust surveillance of CVDs are nascent (53,54), in the Namibian context, the challenges experienced with improved data quality and continuous use of information (212) are addressed through the development of the framework. Routine tracking and evaluating of targeted activities will expedite the achievement of the NCD targets set in the United Nation’s Sustainable Development Goals and the Post-2015 Development Agenda in the Khomas region.

Lastly, during this process onsite-data-verification and recurrent programme evaluation will be used to compare surveillance results with surveillance objectives as identified under step 2 to ensure that it is achieved.

5.7 INCORPORATING ASPECTS OF THE DONABEDIAN MODEL AND ELEMENTS OF ALLAKI’S PHST THEORY

The Donabedian model is known for its flexibility to be applied in diverse health settings such as improving patient flow or information exchange, the quality of chronic disease management, and measuring health outcomes at any level of implementation. Therefore, this model was also used to streamline the discussion on the development of the conceptual framework for this study. Each of these aspects embedded in the tailor-made conceptual framework is summarised below.



Figure 5.3 Filing cabinet at clinic XX

5.7.1 Structure

According to Donabedian (1966), the structure outlines the conditions under which health care is taking place. Donabedian, moreover, refers to the structure as input measures used to enable the implementation of the conceptual framework (10). This study was conducted within the structures of targeted health facilities in the Khomas region in the context of the MoHSS. At this early stage, it is necessary to identify attributes that are in line with the study findings, central concept, and the relevant theoretical reasonings. For this study, under the structural element the attributes of the service or service provider such as healthcare workers, PLHIV initiated on ART, the ART programme operating in an enabling environment, the health care system culture, material resources (infrastructure, and equipment), and existing legislation (multisectoral NCDs strategic plan, guidelines, and operational procedures) validated the success of the process element (prediction and tracking) and outcomes element (increased overall health status of PLHIV initiated on ART).

As part of the surveillance planning, information generation processes such as collection, collation, analysis, reporting, and usage of CVDs risk factors informs the measurement of health outcomes for PLHIV initiated on ART.

In a nutshell, the abovementioned structural attributes played a pivotal role in delineating the activities for the development, implementation, and evaluation of a surveillance framework that will enhance the prediction and tracking of CVDs risk factors among PLHIV initiated on ART in the Khomas region. This phase focussed on the mitigation of *lack of capacity to enhance the integration of CVDs into HIV* and *inadequate strategies, policies, and guidelines*. The predominant structural element is depicted below:

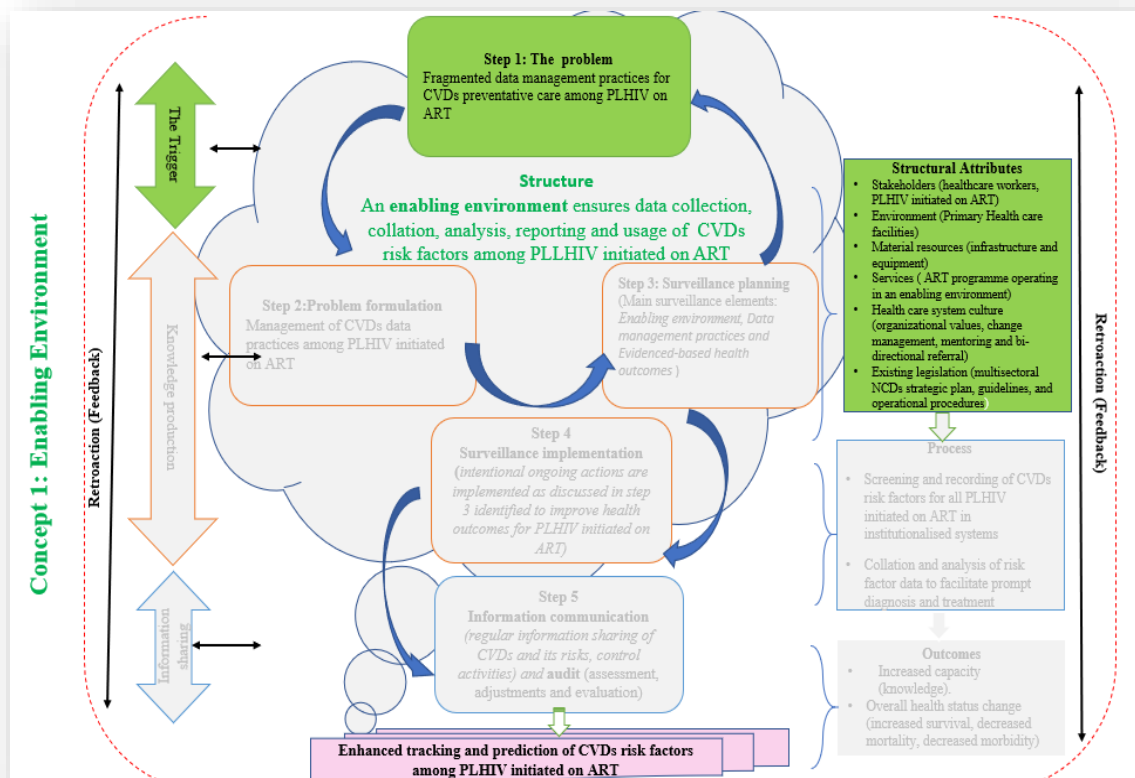


Figure 5.4 Conceptual reasoning: The structure (Mahalie, 2019)

5.7.2 Process

The process component describes whether or not a specific activity was implemented correctly. During the process element, health-related problems are identified, and actions are executed by healthcare workers and beneficiaries that enable them to achieve the intended health interventions and desired outcomes. Informing efficient health service delivery requires going beyond traditional indicators and moving into demand for evidence, dialogue, and data sharing at each level of service implementation. Quarterly data review meetings that will provide a platform for health data managers to analyse and interrogate data to streamline information needs and subsequent targeted interventions for PLHIV initiated on ART is advocated for by the researcher. For example, the findings of the study revealed that current data management processes are not well coordinated therefore the need of intensifying the identification of CVDs

risk factors among PLHIV and taking the necessary actions to circumvent any missed opportunities. Issues like *inconsistent screening, capturing, and aggregation of risk factors of CVDs; missing and incomplete data on CVDs risk factors for PLHIV initiated on ART; and sporadic data analysis, reporting, and feedback* are mitigated at this level. In this regard, *screening and recording of CVDs risk factors for all PLHIV initiated on ART in institutionalised systems; collation and analysis of risk factor data to facilitate prompt diagnosis and treatment; and regular reporting and documented feedback*. The processes followed to mitigate these issues are highlighted below:

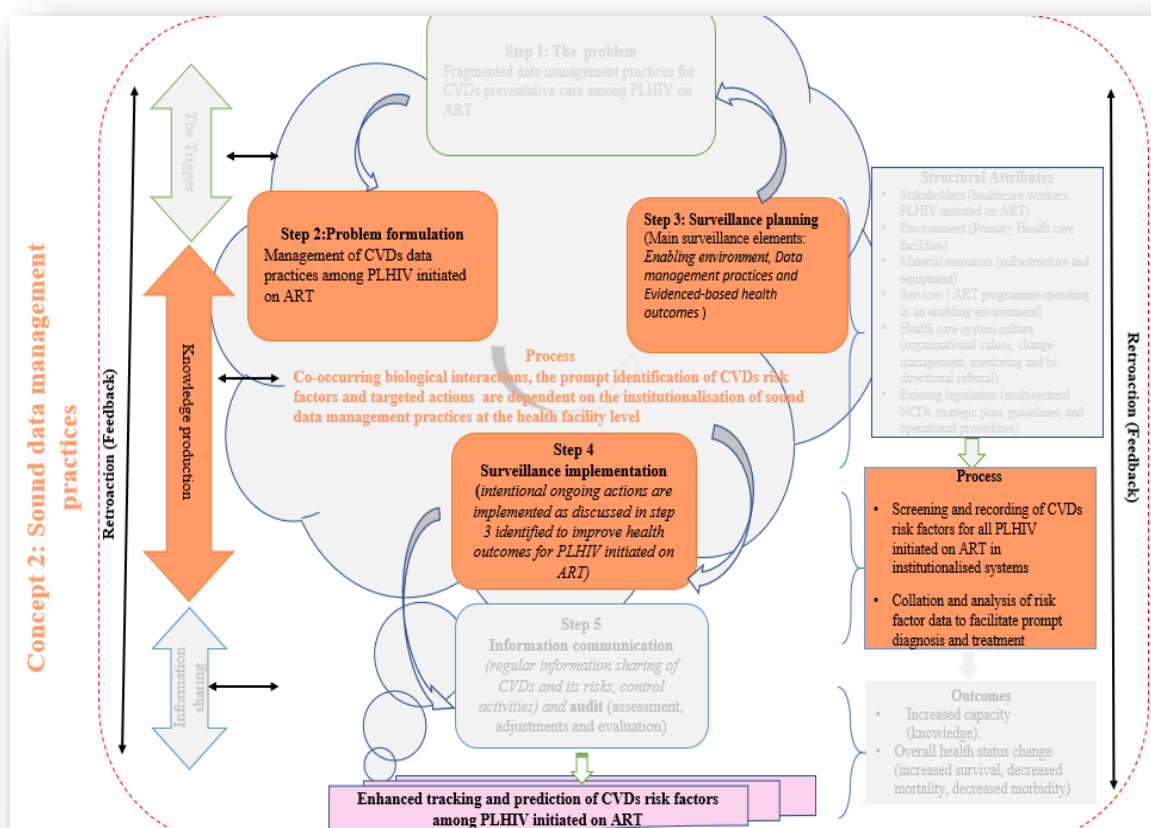


Figure 5.5 Conceptual reasoning: The process (Mahalie, 2019)

In addition, under this aspect, a few central features are highlighted below that warrant the envisaged tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART.

- **Efficiency** measures how productively inputs (money, time, equipment, personnel, etc.) were used in the creation of outputs (products, outcomes, results). An efficient organisation is one that achieves its objectives with the most resourceful expenditures of resources. In a related vein, the lack of standardised or harmonised data management practices at the health facility level is mitigated by introducing functional surveillance and monitoring activities that will ensure integrated routine measuring of CVDs health outcomes for PLHIV initiated on ART.
- **Longitudinality** is explained by Ferrer et al., as a patient-centred approach whereby the deliberate efforts are embarked on to establish an interpersonal relationship between patient and provider to facilitate continuity of health care provision(213). In this study, longitudinality refers to the degree of how users of a service (PLHIV initiated on ART) recognise the need of identifying themselves being provided at health facilities and the bond established between them and the health care worker (nurses, doctors, data clerks, pharmacists, etc).
- **Comprehensiveness** refers to as the ability to identify health-related problems to take the necessary actions to address these problems in a timely fashion. Identifying CVDs risk factors while PLHIV initiated on ART visits the health facility for follow-up treatment encourages the health worker to intervene immediately without referring the client in the event of any abnormal vital signs.
- **Coordination** is another characteristic of the process component whereby once CVDs risks are identified; integration is streamlined by providing subsequent health interventions in a coordinated fashion at the health facility. Ultimately this is done to ensure comprehensive service provision that will enhance the tracking of CVDs risk

factors among PLIHV initiated on ART. By so doing, integrated health service provision is measured and evaluated.

The last phase relates to outcomes which will be discussed below.

5.7.3 Outcomes

The third conceptual reasoning refers to the end-points of an intervention or treatment. This is the last component of the Donabedian SPO model known as outcomes, which relates to the desired results or an effect or consequence of a particular activity, which the stakeholders and beneficiaries anticipate having (137). In this phase, the ‘so what’ question ought to be answered. For example, health care workers who received capacity building on sound data management practices to ensure tracking of CVDs risk factors among PLHIV initiated on ART, had an increase in their knowledge but are they applying what they were taught. Outcomes rely heavily on a practical structural component and flexible process to achieve the results.

As part of information communication and audit as outlined under the PHST, targeted and comprehensive reporting and regular review processes ought to be done by relevant data managers.

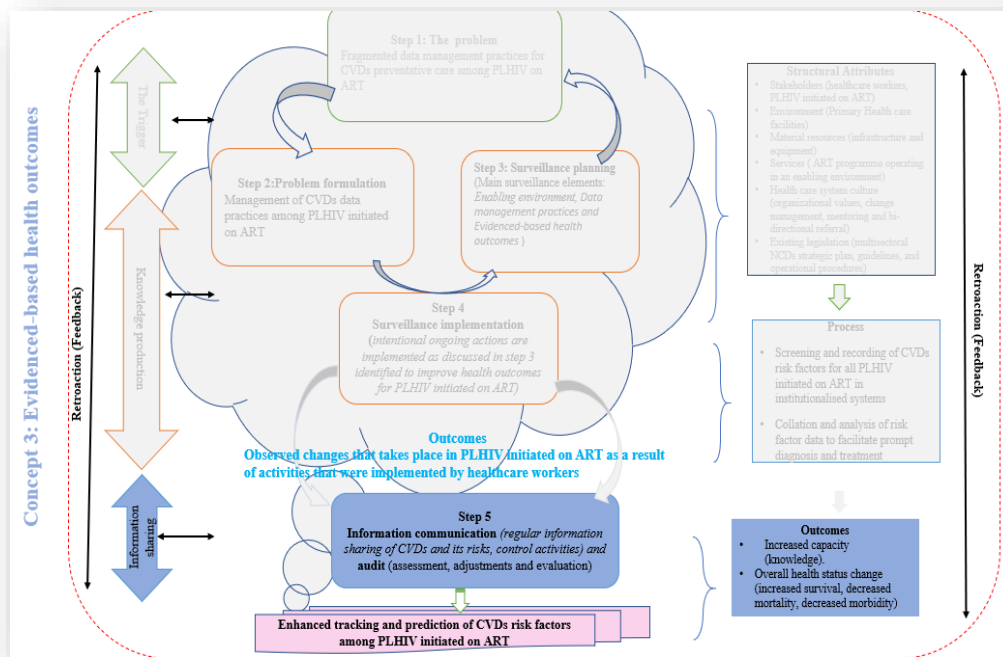


Figure 5.6 Conceptual reasoning: The outcomes (Mahalie, 2019)

Under this element, the following qualities below will determine whether CVDs risk factors are tracked among PLHIV initiated on ART.

- Effectiveness** measures the degree to which outcomes and objectives have been achieved. To measure client satisfaction (accessibility and responsiveness) on the implementation of the surveillance framework among PLHIV initiated on ART as well as continual buy-in from health workers (continuity), the double loop **adaptive management** approach was tailor-made and adopted. **Adaptive management** is defined as “an intentional approach to making decisions and adjustments in response to new information and changes in context” (source ADS 201.6). This approach is ideal for learning about and understanding complex systems and structures as it recognises that systems are inherently changing and unpredictable. Through these efforts the tracking and prediction of health outcomes of CVDs risks are periodically evaluated, frameworks/statements, and cause-and-effect linkages are revisited, to ensure its validity in terms of what was learned during the implementation and evaluation of the framework.

- **Increased capacity (knowledge)** is defined in the Merriam Webster (1828) as increased capacity as the ability to become progressively higher (as in size, amount, number, or intensity). In the context of this study, increased capacity relates to increased knowledge, which means learning has taken place to absorb the relevant content within one's sphere of influence. In this instance, all relevant stakeholders are well informed about the surveillance framework that tracks and predicts CVDs risks.
- **Overall health status change (increased survival, decreased mortality, decreased morbidity)** is a critical quality under this element. In this study, **decreased morbidity** and **mortality** were considered as some of the critical outcomes of the implementation of the surveillance framework to describe the progression and severity of CVDs in PLHIV initiated on ART. Thus, changes in **survival** of PLHIV initiated on ART are envisaged to increase drastically, resulting in a difference in the overall health status subsequently. Epidemiologist defines morbidity as the state of being symptomatic or unhealthy for a disease or condition whilst mortality, is related to the number of deaths caused by the health event under investigation. In a similar vein, accurate assessment of these measures is crucial to understanding and evaluating their impact and trajectory. The abovementioned attributes would, in turn, contribute to the overall national goal and SDGs, such as increased quality of life for PLHIV initiated on ART.

5.8 MERGING OF STATEMENT, CENTRAL CONCEPTS, AND CONCEPTUAL FRAMEWORK

The reasoning map refers to the outline/summary of the identified concepts. Donabedian's three elements which comprise of the structure, process, and outcomes were fused into the six elements of El Allaki et al., (trigger, problem formulation, surveillance planning, surveillance implementation, and information generation and audit) together with the findings from the

study, to delineate the researcher’s reasoning map. These interrelated elements were discussed in relation to the central concepts such as **enabling environment**, **sound data quality management practices**, and **evidenced-based health outcomes** which contributed to the development of the surveillance framework to track CVDs risk factors and predict health outcomes among PLHIV initiated on ART thus fulfilling the purpose of the study. This synopsis is graphically demonstrated below in figure 5.7.

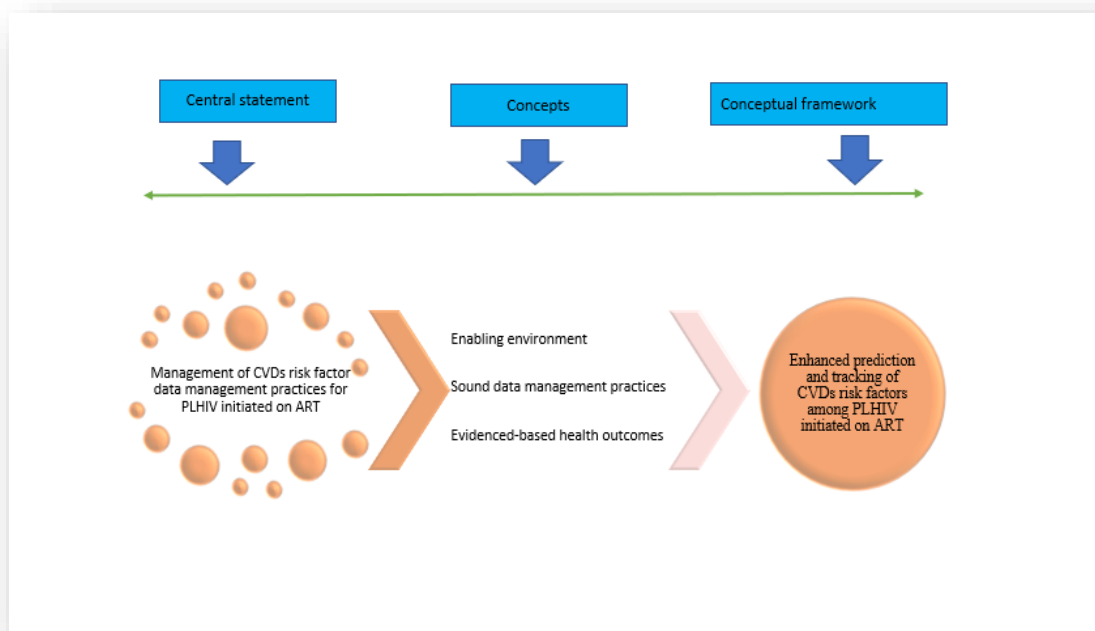


Figure 5.7 Merging of the statement, central concepts, and conceptual framework (Mahalie, 2019)

5.9 SUMMARY

The conceptual framework of the study was developed and presented in this chapter. The development of the conceptual framework was informed by Donabedian’s three elements which comprise the structure, process, and outcomes. The elements were fused into the PHST theory incorporated steps such as a trigger or need; problem formulation; surveillance planning; surveillance implementation as well as information communication and auditing of agreed-

upon indicators. These theories/models, together with the findings from the study, were utilised to develop the conceptual framework that will enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART. The surveillance framework is presented in the next chapter.

CHAPTER 6: DEVELOPMENT AND DESCRIPTION OF A NOVEL SURVEILLANCE FRAMEWORK TO FACILITATE ITS IMPLEMENTATION

6.1 INTRODUCTION

The preceding chapter describes the conceptual framework which formed the basis for the objectives and the contents for the surveillance framework that enhances the tracking and prediction of health outcomes of cardiovascular diseases risks among PLHIV initiated on ART. This chapter focuses on developing, describing the framework, and learning model to facilitate its implementation, which builds on the discussions of the previous chapters.

6.2 METHODOLOGY OF THE FRAMEWORK

The study followed a qualitative-quantitative cross-sectional sequential research design. The origin and development of the framework were substantiated with an analysis of the existing literature on surveillance, monitoring of CVDs risk factors and PLHIV initiated on ART. In addition, the results obtained from data analysis of in-depth interviews and primary data of CVDs risk factors garnered from patient care booklets at the targeted health facilities played significant role in streamlining the methodology of the framework. Synthesis and derivation of concepts in Phase 2 also informed the development of the framework. The research methodology for this study is discussed in detail in Chapter 3.

The outcome of the situational analysis revealed the following:

- Lack of standardised or harmonised data collection and analysis efforts for CVDs risk factor data at the health facility level to ensure integrated routine measuring of CVDs health outcomes for PLHIV initiated on ART (qualitative).

- Health risk factors for CVDs, such as high blood pressure, obesity, smoking, and alcohol use, are considerably prevalent among PLHIV initiated on ART (quantitative).
- Missing and incomplete data have a significant effect on accurate surveillance of cardiovascular diseases among PLHIV initiated on ART (quantitative).

In addition, the conceptualisation of the study findings led to the framing of central concepts such as enabling environment, sound data quality management practices, and evidenced-based health outcomes which led to the development of the surveillance framework to enhance tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART.

The summary of the methodology followed is depicted in figure 6.1.

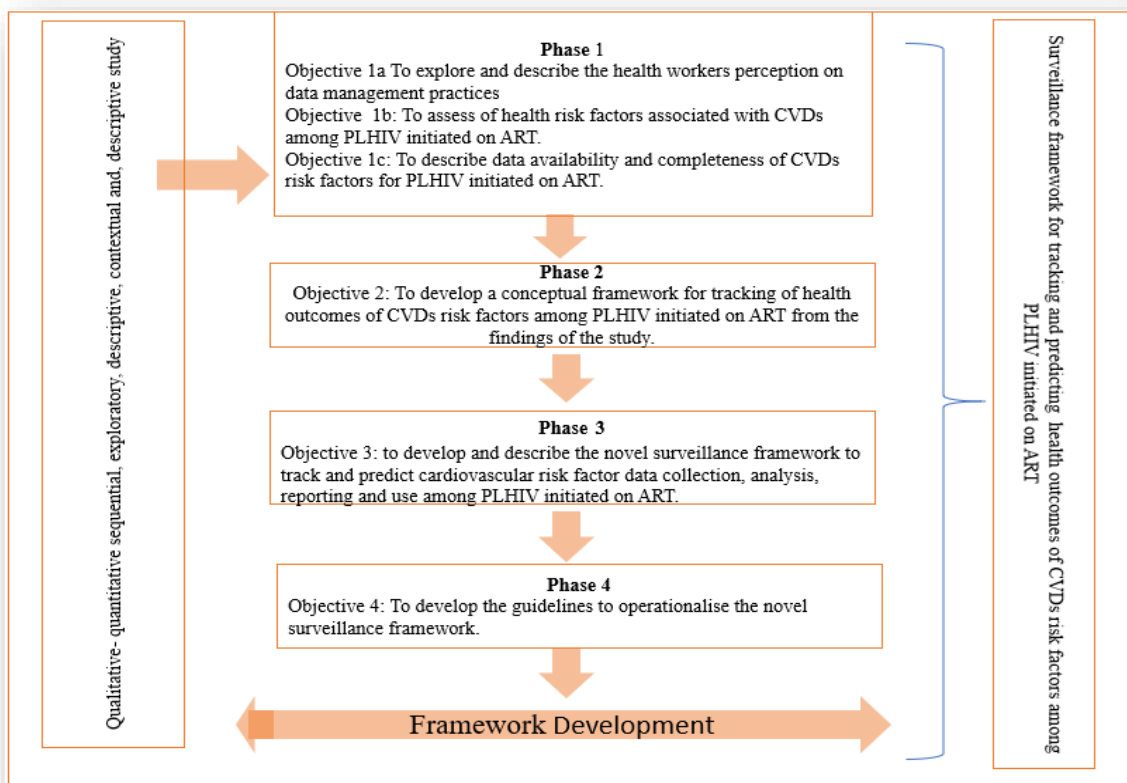


Figure 6.1 Schematic presentation of the methodology applied in the study.

6.3 OVERVIEW OF THE FRAMEWORK

The six proposed descriptive strategies of Chinn and Kramer (2011) namely the purpose, concepts, definitions of concepts, relationships, structure, and assumptions were used to describe the surveillance framework. An overview of the framework is schematically presented in figure 6.2, followed by a description of the components of the framework.

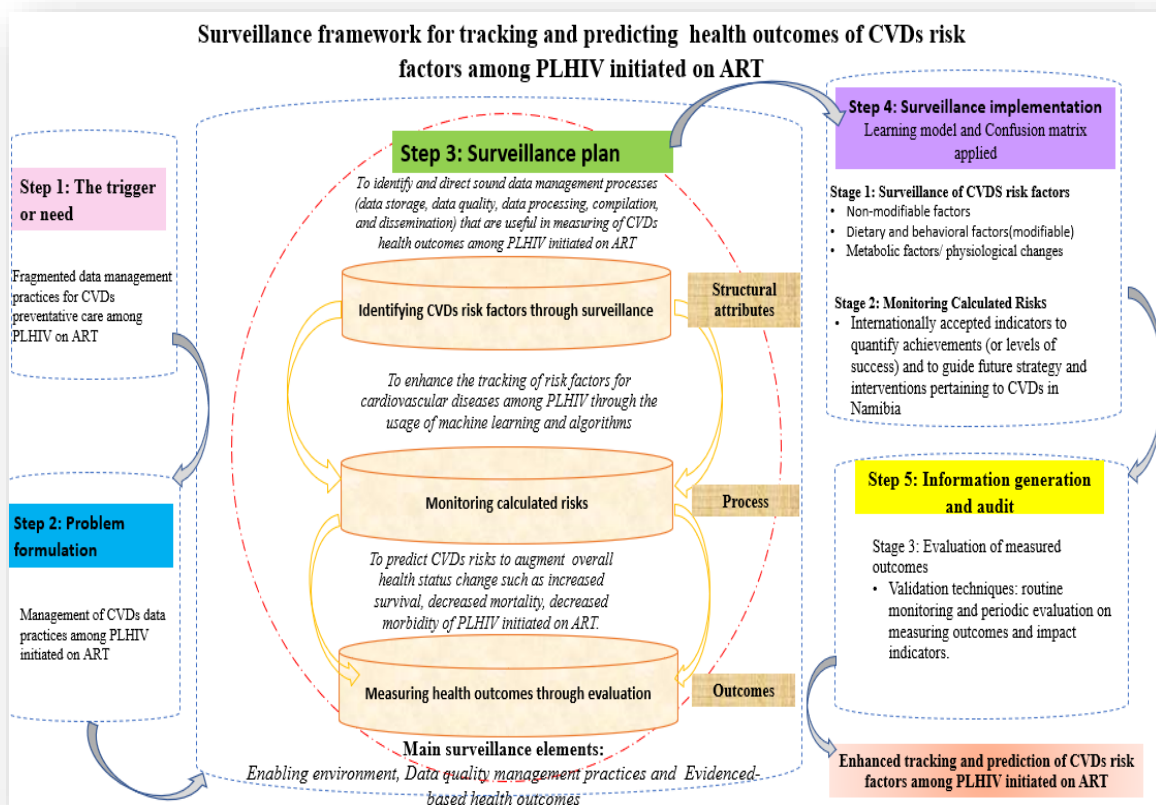


Figure 6.2: Overview of the surveillance and monitoring framework (Mahalie,2019)

6.4 STRUCTURE OF THE FRAMEWORK

The surveillance framework for tracking CVDs risk factors among PLHIV initiated on ART has three interrelated components, namely, *identifying CVDs risk factors* (enabling environment; *the problem*), *monitoring calculated risks* (sound data management practices;

knowledge production), and *measuring health outcomes* (integrated evidenced-based health outcomes; *information sharing*) which contributed to the initial purpose of the framework. The theoretical underpinnings of the Population Health Surveillance Theory (PHST), Avedis Donabedian's SPO Model, and Arthur Samuel's machine learning model of 1959 provided a useful guide to structure the framework that could enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART. The schematic presentation of these aspects as depicted in figure 6.2 is described as follows:

- ✓ The steps of the PHST model followed to conceptualise major concepts and to provide structure for the surveillance framework to track and predict health outcomes of cardiovascular diseases risks among PLHIV initiated on ART are highlighted in various colours.
- ✓ The concepts are listed in italics under each surveillance guide.
- ✓ The red dotted line in the outer frame around the structure represents the surveillance framework.
- ✓ The oval the amber coloured flowcharts within the red dotted line represents structural attributes needed to identify CVDs risk factors of PLHIV initiated on ART through sound data management practices; all that occurs (**processes**) to monitor calculated risks, and changes in the state of health (**outcomes**) of PLHIV initiated on ART within and beyond the health facilities intervention's sphere of influence thus measuring health outcomes.
- ✓ The complementing model (Donabedian SPO model) on the extreme right end is represented by brownish texture shapes.
- ✓ The black arrows provide a clear demarcation between each of the 3 aspects and the guides the direction as postulated by the adopted theoretical underpinnings (130,137,140,208,214).

- ✓ The different arrows indicate the direction and relationship between the areas.
- ✓ The ultimate goal of the framework, which is to enhance tracking and prediction of health outcomes of CVDs risk among PLHIV initiated on ART in Khomas region.

6.5 PURPOSE OF THE FRAMEWORK

The main purpose of the surveillance framework is to provide a theoretical framework to enhance the tracking and prediction of health outcomes of CVDs risks which were not considered in the traditional reporting system.

6.6 STEPS OF THE SURVEILLANCE FRAMEWORK

6.6.1 Step 1: The Trigger or Need

The lack of integration of data sources, both for effective patient-centred clinical management and for surveillance of CVDs risk factors for PLHIV initiated on ART.

6.6.2 Step 2: The Problem Formulation

During the problem formulation, specific objectives were identified that could facilitate the process of developing the surveillance framework that enhances the tracking of CVDs risk factors among PLHIV initiated on ART. The objectives are as follows:

- To enhance routine tracking of risk factors for cardiovascular diseases among PLHIV through the usage of machine learning and algorithms. The situational analysis revealed that missing value patterns were mostly found for critical parameters such as alcohol, smoking, and those at risk of increased BMI, thus ensuring an **enabling environment** was the obvious choice.
- To predict and direct sound data management processes (data storage, data quality, data processing, compilation, and dissemination) that are useful in measuring of CVDs health outcomes among PLHIV. Since missing data was detected during the data extraction exercise **data quality management practices** were introduced.

- To promote the integration and utilisation of CVDs risk factor data in program planning and management useful for measuring health outcomes (**evidenced-based health outcomes**). The study findings also revealed that data reviews and documented feedback is happening sporadic, therefore integration and use of CVDs risk factor data were incorporated into the development of the surveillance framework. This information is critical for not only disease control but also to adhere to international obligations such as the achievement of NCD targets set in the United Nation’s Sustainable Development Goals and the Post-2015 Development Agenda (59,74).

6.6.3 Step 3: Surveillance Planning

This step revolves around the entire process of information generation which includes processes such as collection, collation, analysis, reporting, and usage of health-related data from a variety of sources, as well as the creation and distribution of health information products (208).

The steps followed to achieve each of these surveillance objectives are discussed individually in the subsequent sections.

- ✓ *To identify and direct sound data management processes (data storage, data quality, data processing, compilation, and dissemination) that are useful in measuring of CVDs health outcomes among PLHIV initiated on ART.*

The surveillance planning process under this objective was guided by Arthur Samuel’s machine learning model of 1959, which is described as the ‘ability given to a computer to learn without being explicitly programmed’(140). The proposed surveillance framework was developed to

enhance the tracking of cardiovascular risk factor among PLHIV initiated on ART at health facilities in the Khomas region using the following sequence shown in figure 6.3 below:

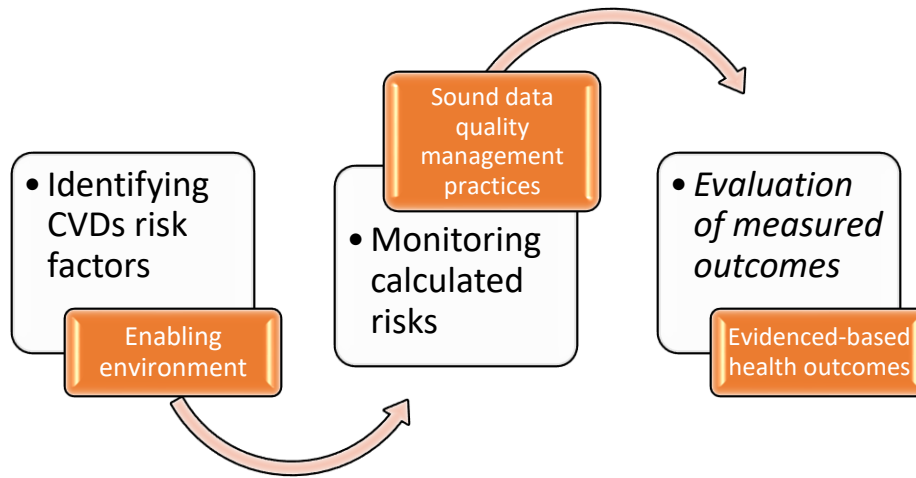


Figure 6.3 Proposed sequence for the framework development

A key attribute in this process is that learning has to take place to ensure health care workers are conversant with the process of identifying and integrating routine tracking of CVDs risk factors among PLHIV initiated on ART.

The definition of learning by Tom Mitchell (as cited in Firdaus et al.,) (140) was adopted in the context of this study whereby the system of a computer program is instructed to learn from experience (E) concerning some task (T) and some performance measure (P). Learning is defined as the ‘acquisition of knowledge or skills through study, experience, or via a process of teaching’(140).

Furthermore, Firdaus, Hassan, and Kaur postulate that such learning models are also ideal for diagnosis, prognosis, and surveillance (140). Additionally, Zheng et al., also underscored the effectiveness of the learning model which was used to identify, evaluate, and contrast the Type 2 Diabetes Mellitus performance through electronic health records (15). The supervised

learning applications have special features that have built-in predictive, proactive, and preventive lifesaving technology (140), appropriate for calculating risks of cardiovascular diseases among PLHIV as depicted in figure 6.4.

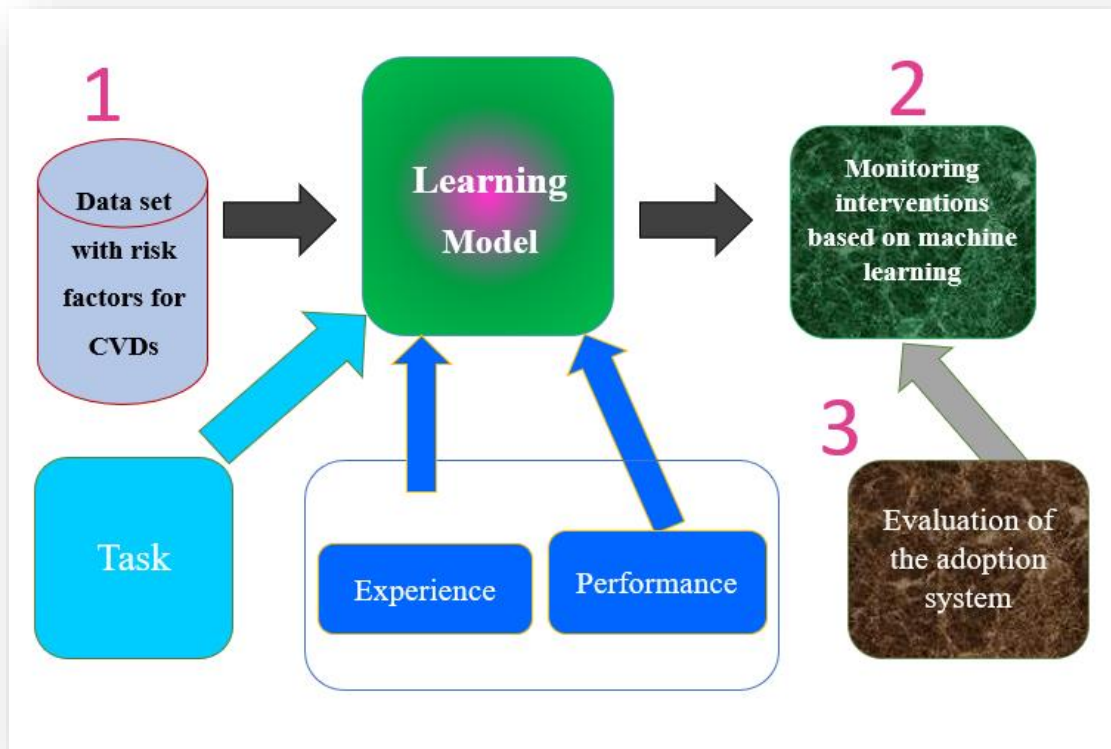


Figure 6.4: Supervised learning model for CVDs risk factors among PLHIV initiated on ART.

During this process, the Donabedian structural attributes played a significant role in building the necessary capacity for all stakeholders (healthcare workers and PLHIV initiated on ART). This is done by the following surveillance objective.

- ✓ *To enhance the tracking of risk factors for cardiovascular diseases among PLHIV through the usage of machine learning and algorithms*

In the second objective, under surveillance planning risk for CVDs is predicted based on sound data quality management practices. It involves the synthesis of critically evaluated information and data captured from the patient visiting the clinic for ART follow-up as part of surveillance.

The outcome of such a prediction can be communicated to health care workers and national policymakers for programme decision making. The confusion matrix checks the performance and effectiveness of the results using parameters/metrics as outlined below:

- True Positive (TP): A true positive test result is one that detects the cardiovascular risk when the condition is present.
- False Positive (FP): A false-positive test result is one that detects a cardiovascular risk when the condition is absent.
- True Negative (TN): A true negative test result is one that does not detect the cardiovascular risk when the condition is absent.
- False Negative (FN): A false negative is a test result that indicates that one does not have a cardiovascular risk when the person does have it.

Through the introduction of artificial intelligence in this study, large data sets from ePMS were used to predict risks of CVDs among PLHIV initiated on ART. The proposed framework used the logistic regression classifier, which acquired data from the monitoring system dataset measure accuracy and predicts whether the PLHIV initiated on ART is at high risk of contracting CVDs or not. The logistic regression classifier was chosen due to the small amount of data the researcher had acquired (less than 5000) but could be extended to more advanced deep learning algorithms when sufficient data becomes available. In order to produce the best possible results, the classifier is evaluated using accuracy and the confusion matrix for the proposed surveillance and monitoring framework (15,215).

Below is an extract of an example of a library that needs to be imported into the python notebook (214) for the health data managers to run the logistic regression.

```

In [27]: import pandas as pd
         from sklearn.model_selection import train_test_split
         from sklearn.linear_model import LogisticRegression
         from sklearn import metrics
         import seaborn as sn

In [69]: #(use "r" before the path string to address special character, such as '\').
         #Don't forget to put the file name at the end of the path + '.xlsx'
         patients = pd.read_excel(r'C:\Users\Dr. Nggada\Desktop\Mahalie.xlsx')
         print (patients)

```

	Age	Weight	Height	BP_Systolic	Admitted
0	47	51.0	158.0	100	0
1	30	45.0	165.0	120	1
2	26	46.0	156.0	110	0
3	45	55.7	175.2	110	0
4	40	47.0	164.0	150	1
5	40	74.0	165.5	128	1
6	40	74.2	164.0	100	0
7	29	68.0	165.0	120	1
8	48	71.0	174.0	130	1
9	49	58.0	184.0	120	1
10	35	34.0	150.8	100	0
11	30	55.7	147.0	118	0
12	24	71.5	167.5	110	0
13	36	65.4	177.0	130	1
14	24	71.0	171.0	140	1
15	44	88.8	159.0	170	1
16	38	46.0	160.0	116	0
17	38	61.0	174.0	120	1
18	51	56.0	167.0	130	1
19	51	71.3	166.8	130	1
20	35	70.5	163.0	110	0
21	51	48.0	166.5	120	1
22	32	59.9	157.0	110	0
23	34	60.2	180.0	120	1
24	35	68.0	163.0	110	0
25	29	60.7	166.3	140	1
26	43	74.5	175.5	160	1
27	27	66.6	158.0	120	1
28	29	72.5	158.0	100	0
29	43	43.5	155.0	140	1
...
499	41	59.7	157.0	162	1
500	56	80.0	154.0	164	1
501	28	47.7	153.6	164	1
502	28	68.6	163.0	140	1
503	26	69.0	173.0	159	1
504	41	85.2	154.4	101	0

Figure 6.5: Library 1 exported to python notebook

After running the accuracy of the data, it is revealed in input 77, True Positives are rated at 97% whilst False Negatives are rated a 6%.

```

In [71]: X = df[['Age', 'Weight', 'Height', 'BP_Systolic']]
         y = df['Admitted']

In [72]: X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_state=0)

In [73]: #Apply the logistic regression as follows:
         logistic_regression= LogisticRegression()

In [74]: #Apply the logistic regression as follows:
         logistic_regression= LogisticRegression()
         logistic_regression.fit(X_train, y_train)
         y_pred=logistic_regression.predict(X_test)

In [75]: #Then, use the code below to get the Confusion Matrix:
         confusion_matrix = pd.crosstab(y_test, y_pred, rownames=['Actual'], colnames=['Predicted'])
         sn.heatmap(confusion_matrix, annot=True)

Out[75]: <matplotlib.axes._subplots.AxesSubplot at 0x655b1c8ef0>

```

```

In [77]: print('Accuracy: ', metrics.accuracy_score(y_test, y_pred))
         #As can be observed from the matrix:
         #TP = True Positives = 97
         #FN = True Negatives = 5
         #FP = False Positives = 25
         #FN = False Negatives = 6
         Accuracy: 0.7669172932330827

```

Figure 6.6: Library 2 Rating of True Positives and False Negatives

- ✓ *To predict CVDs risks to augment overall health status change such as increased survival, decreased mortality, decreased morbidity of PLHIV initiated on ART*

The qualitative findings of the study revealed that health facilities lacked standardised ways of managing risk factor data as reiterated in the statements below:

- *Lack of an integrated system that encourages regular, institutionalised feedback on CVDs and its risk factors for subsequent interventions among PLHIV initiated on ART.*
- *Lack of standardised/institutionalised strategies, policies, and guidelines to facilitate regular integrated CVDs risk factor surveillance and M&E among PLHIV.*
- *Lack of knowledge of the existence of the national strategy on NCDs.*

Therefore, the researcher opted to use the abovementioned proposed multivariate classification learning algorithm to harmonise and link reporting to current efforts of the MoHSS by predicting the outcome of the following indicator:

- *Probability of dying between ages 30-70 years from cardiovascular disease among PLHIV initiated on ART.*

The accuracy of the model was tested with 5 new patients. CVDs risk is predicted which indicates, for example, that patient 1 is at risk and requires further health intervention as depicted below.

```

In [93]: #predict the risk factor of a new patient
new_patients = {'Age': [50,70,68,61,71],
                'Weight': [75,70,65,80,50],
                'Height': [160,170,165,165,175],
                'BP_Systolic': [118, 120, 110, 120, 105]
                }
df2 = pd.DataFrame(new_patients,columns= ['Age', 'Weight', 'Height', 'BP_Systolic'])
print (df2)
y_pred=logistic_regression.predict(df2)
print(y_pred)

   Age  Weight  Height  BP_Systolic
0   50     75    160         118
1   70     70    170         120
2   68     65    165         110
3   61     80    165         120
4   71     50    175         105
[1 1 1 1 0]

In [ ]: #interpretation
# patinet 0 should be admitted
#patient 1 to be admitted
# patient 2 to be admitted
#patient 3 to be admitted
#patient 4 to be released

```

Figure 6.7: Library 3 Risk prediction and alert for possible intervention

The accuracy of this model is determined by the completeness and availability of data at the collection and collation level.

The study findings revealed missing value patterns which are more inclined towards alcohol, smoking, and those at risk of increased BMI. A lower concentration is observed in the last ART status and high blood pressure. Non-missing variables are mostly observed in sex, age, and average follow-up days. It was further revealed that 73.72% of the cases were presented with missing data while 41.18 % of the variables were incomplete (see chapter 4).

The success of any health intervention using ‘add-on computer software’ for clinical decision support, depends on regular formal and informal review points with constant modification in the ever-evolving situations of health service delivery (216). Therefore, feedback loops

intensify the continuous monitoring of progress, addressing constraints, and vies for new opportunities arising from the changing situation.

6.6.4 Step 4: Surveillance Implementation

The surveillance implementation was done in two stages such as surveying CVDs risk factors and monitoring calculated risks.

6.6.4.1 Stage 1: Surveillance of CVDS risk factors

In a workshop proceeding on public health surveillance, Dr Amal reiterated the significance of good disease surveillance which is grounded on the action and a culture of using accurate information for decision-making based (217). The routine surveillance system provides a mechanism for the registration, detection, collection, managing and reporting on the inputs, activities, and outputs for (i) monitoring exposure (risk factors and determinants), (ii) outcomes (morbidity and disease-specific mortality), and (iii) health system response and capacity (187)of CVDs among PLHIV initiated on ART.

As the patient enters the health facility for enrolment or initiation on ART, critical vital signs/parameters are captured by the health assistants or NIMART nurses such as:

- Demographic data (age, gender, family history, race/tribe) for first-time visitors to the ART clinic.
- Other socio-demographic data (region, employment status, educational status) for first-time visitors to the ART clinic.
- Behavioural and dietary history (smoking, alcohol, dietary patterns, physical activity) for the first time and follow-up patients.

- Metabolic/physiological factors (blood pressure, blood sugar levels, weight, height, and cholesterol) for the first time and follow-up patients (where appropriate).

Common CVDs risk factors are outlined in figure 6.8 below:

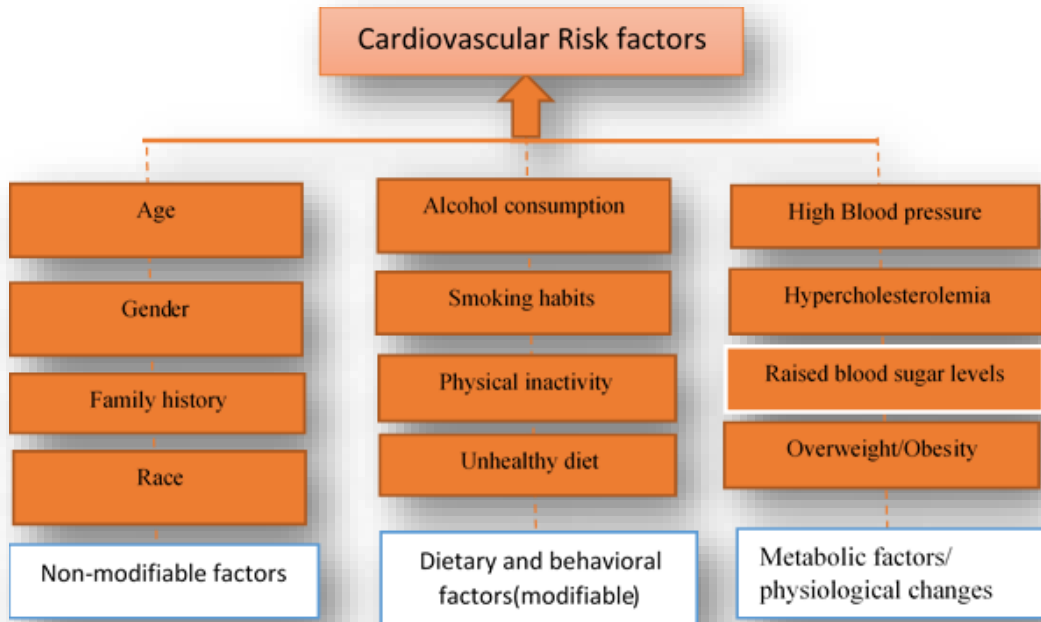
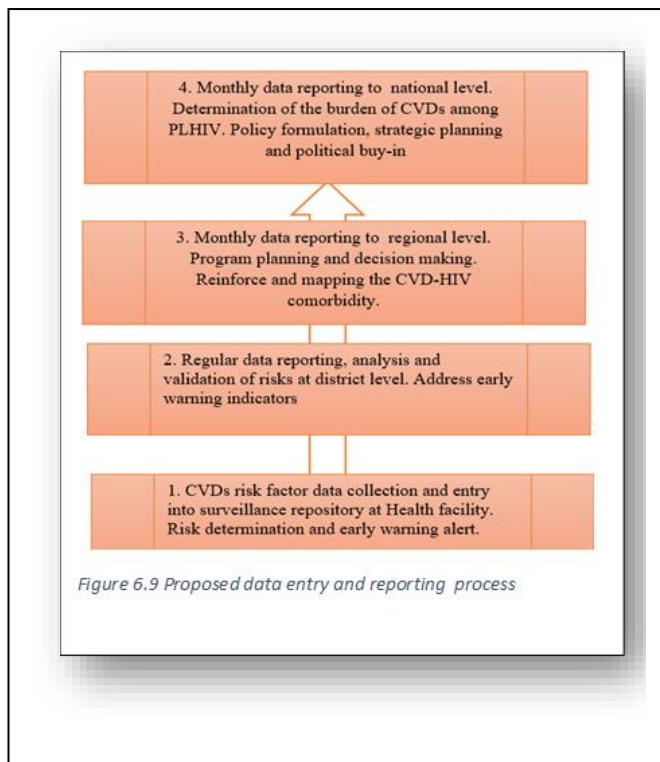


Figure 6.8: CVDs Risk Factors

The above-mentioned real-time data is captured and entered into the prototype CVDs surveillance system. Current task-shifting efforts and skills mix at the health facilities to enhance the detection of CVDs, and disease-control management was used for this study. For example, health assistants were tasked with the responsibility of collecting raw CVDs risk factor data in the patient care booklet (PCB) and the health passport of the patient. Generic tally sheets from the MoHSS are used for daily



census/statistic purposes. Dedicated data entry clerks are responsible for entering the data into the surveillance data repository. Built-in features analyse the data and generic individual patient reports which are forwarded to the next reporting level (district). The build-in data quality check and quality assurance processes are done internally before reports are submitted to the next level.

The researcher is aware that human capacity building for M&E requires a wide range of activities. Therefore, formal training, in-service training, mentorship, coaching, and internships receive priority during this stage.

6.6.4.2 Stage 2: Monitoring Calculated Risks

In this stage, learning algorithms were developed and incorporated to instruct the surveillance data repository to calculate the CVDs risks for PLHIV from consolidated data. The development process of this stage was done under the guidance and supervision of the project

supervisors and a technical expert in computer science. Java environment was used for simulation and evaluation (218,219). The established selection of archival datasets captured in stage 1 undergoes the cleaning of pre-processing and visualisation. This process is highly dependent on artificial intelligence to continue to keep track of CVDs, predict health outcomes, and improve health interventions.

For monitoring cardiovascular risk factors of PLHIV, specific indicators were adopted which were informed by the World Health Organization Package of Essential Noncommunicable Disease Interventions (WHO PEN) for Primary Health Care in Low-Resource Settings (39,220,221). The purpose of these internationally accepted indicators is to quantify achievements (or levels of success) and to guide future strategy and interventions pertaining to CVDs in Namibia. The proposed indicators were carefully selected based on the major study findings and proposed indicators outlined in the National Multisectoral Strategic Plan For Prevention and Control of Non-Communicable Diseases in Namibia 2017/18 – 2021/22(39) such as:

- **Monitoring exposure of CVDs risk factors among PLHIV:**
 - Age-standardised prevalence of raised blood pressure among adults aged 18+ years (defined as systolic blood pressure \geq 140 mmHg and/or diastolic blood pressure \geq 90 mmHg).
 - Age-standardised prevalence of obesity and overweight among adults aged 18+ years.
 - Age-standardised prevalence of current tobacco smoking among persons aged 15+ years.
 - Total (recorded and unrecorded) alcohol per capita (15+ years old) consumption within a calendar year in litres of pure alcohol)

- Age-standardised prevalence of insufficiently active adults aged 18+ years (defined as less than 150 minutes of moderate-intensity activity per week, or equivalent).
- **Measuring health outcomes of CVDs risk factors among PLHIV:**
 - Proportion of CVDs health outcomes measured among PLHIV.
 - Retention in care (target >80%).
- **Handling or managing of risk factor data for CVDs:**
 - Improved health systems to ensure the handling and safeguarding of CVDs data and its risk factors among PLHIV.
- **Utilisation of CVD data for decision making:**
 - Proportion of evidence-based decisions taken to inform CVDs health service delivery among PLHIV.

System efficiency requires standard operating procedures which clearly outline the flow of data from one level to the next. Feedback to the reporting units was therefore embedded into the existing reporting requirements. The diagram below depicts the flow of data:

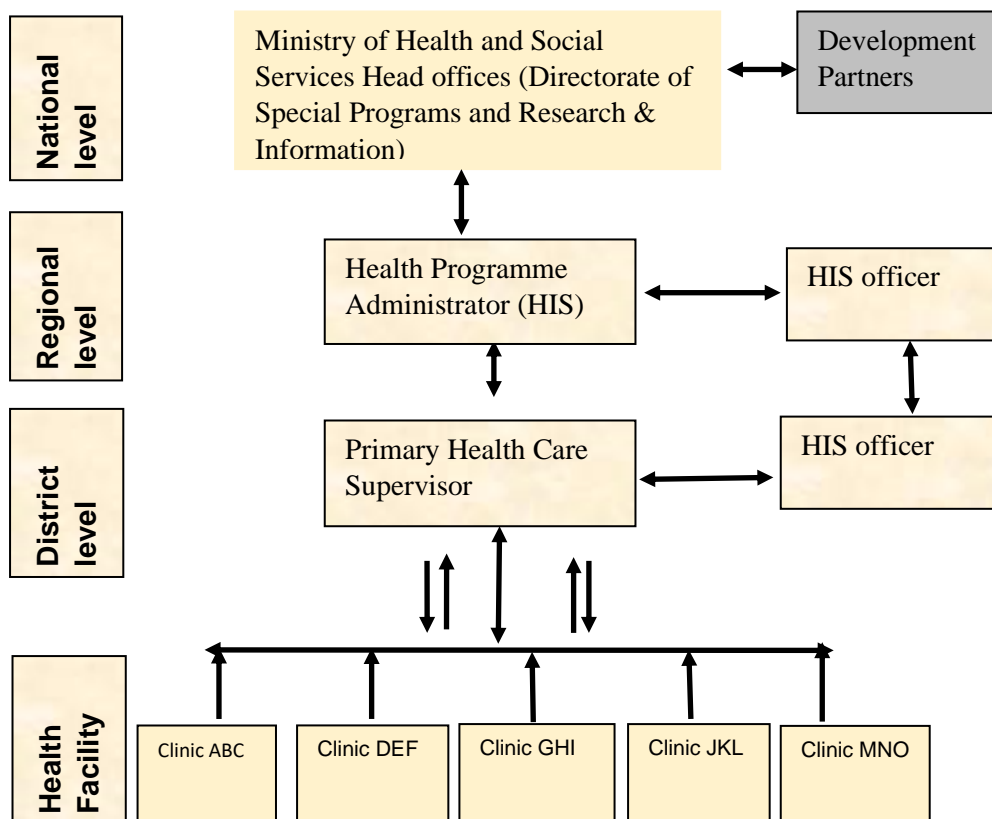


Figure 6.10: Adapted and modified depiction of the data flow (MoHSS, 2017)

The heart of an M&E system is to use the information to enhance decisions that aim specifically at improving strategies, programs, plans, budgets, resource allocation, planning, and implementation.

A variety of information packages are used to generate reports from the results collected during routine data collection at the health facility level. By so doing timely, complete, and reliable periodic results and reports will be disseminated to relevant stakeholders to guide programme decision making and focussed action-planning. Periodically monitoring data related to integrated CVDs health service delivery will improve the credibility of the data and circumvent any obstacles to producing high-quality data.

The study results revealed that data review meetings are happening quarterly for discussion on progress made on Isoniazid-preventative therapy (IPT) implementation and other communicable diseases. Therefore, the researcher proposed the introduction of at least one CVD-related indicator as part of the agenda items to ensure ownership and the health workers' involvement. Such concerted efforts imply that people understand and commit to scheduled M&E activities whilst appreciating the value-addition of the information they generated. Furthermore, the researcher proposed the preparation and dissemination of annual reports; the production of quarterly bulletins, and the sharing of information regarding CVDs health outcomes among PLHIV initiated on ART in the local and international arena.

Data quality assurance methods as well as procedures for supportive supervision to ensure complete, timely, and reliable data that will track programme performance results are outlined below:

- Regular data verification of all data elements captured from patients visiting the ART clinic.
- Quarterly supportive supervisory visits with standardised checklist and feedback report to oversee performance and to transfer knowledge and skills.
- Periodic data quality audits and reviews to verify data for completeness and accuracy of reported disaggregated and aggregated data.
- Training and retraining of staff will continue to play an essential role in ensuring good data quality.

6.6.4.3 Implementation of the surveillance framework

According to Burkov, in machine learning, the classification problem is solved with a certain level of certainty (215). The researcher opted to implement a classification learning algorithm

in the learning model part of the framework. Inputs and output variables were used to assign specific labels that are linked to the surveillance data repository and subsequent data management processes. These input and output variables are regarded as members of a finite set of classes. Since the finite set of classes is larger than two, the researcher opted to use multiclass classification (also called multinomial) which includes three (3) or more classes (215).

The following are the classes proposed by the researcher for each multivariate classification learning algorithm:

Classification of high blood pressure is as follows:

- Elevated blood pressure: Systolic BP (SBP) 120-129 mmHg or diastolic BP <80mmHg;
- Stage 1 high blood pressure: SBP 130 to 139 mmHg or DBP 80 to 89 mmHg
- Stage 2 high blood pressure: SBP \geq 140 mmHg or DBP \geq 90 mmHg(95).
- Hypertensive crises: SBP \geq 180 mmHg or DBP \geq 110 mmHg

Classification of Anthropometric indicators (BMI) are as follows:

- Underweight: <18
- Normal weight: 18 -24.9
- Overweight: 25-<30
- Obese: \leq 30

Classification of data completeness for recordkeeping are as follows:

- Poor recordkeeping: 25%
- Average recordkeeping: 50%
- Good recordkeeping: 75%
- Excellent recordkeeping: 100%

Classification of data completeness related to % missing demographic and other systemic data are as follows:

- At-Risk (inconsistent, incomplete or missing demographic data (Marital status, DOB, Age) and other systemic data (Start ART Year; Total Average of Follow-up days; Total Average of visits per year): 25%
- Not at Risk due to systemic challenges: 75%

In addition, two indicators were identified:

- Duration on ART
- Recorded side-effects due to prolong ART use

By applying logistic regression to the collected data set, the classes presented above were the obvious choice for developing a multiclass classification method to predict a label of a new input value. The multiclass logistic regression algorithm ran on the ePMS dataset, which in this case, is a collection of experiences, and produces new outcomes or make predictions for future benefits in terms of enhancing data management for CVDs and its risk factors among PLHIV initiated on ART.

6.6.5 Step 5: Information Planning and Audit

6.6.5.1 Stage 3: Evaluation of measured outcomes

A validation technique was employed to validate the health outcomes achieved by the learning model effectiveness using the accuracy, sensitivity, and specificity as overall performance metrics. Finally, process evaluation provides evidence-based public health strategies and specific actions linked to all aspects of the CVDs disease prevention, control, and management, as services are provided, thus expediting integrated health service delivery to PLHIV.

The situational analysis of this study revealed that health service delivery around CVDs is happening in isolation, hence the researcher concluded that stakeholder engagement through regular committee meetings, technical working groups, partnership fora are highly recommended. These engagements will enhance constant communication and the discussion around the implementation of the surveillance framework.

Routine monitoring ensures the collection of output indicators (immediate results), whilst periodic evaluation focusses on measuring outcomes and impact indicators. The current trend in Namibia is that long-term results for CVDs rely heavily on population-based surveys. Therefore, through this study, it is suggested that survey data is collected at facility levels and aggregated at the district and regional levels.

As part of the measuring evaluation outcomes, conducting regular operational research will generate new knowledge on the most prevalent risk factors of CVDs and other Non-Communicable Diseases, determine control measures as well as the disease burden. Additionally, it will also identify and address gaps in programme performance promptly. The main findings and modalities of addressing these issues are summarised in table 6.1 below.

Table 6.1: Summary of the surveillance and monitoring framework

Main findings	Modalities of addressing the issues
High prevalence of health risk factors such as high blood pressure, obesity, smoking, and alcohol use among PLHIV initiated on ART.	Surveillance of CVDs risk factors to track and predict them to determine its burden.
Missing and incomplete data that has a significant effect on accurate surveillance and	Introduce sound data quality management practices to ensure accurate data at all levels of reporting.

monitoring of cardiovascular diseases among PLHIV initiated on ART.	
Lack of standardised or harmonised data collection and analysis efforts for CVDs risk factor data at the health facility level to ensure integrated routine measuring of CVDs health outcomes for PLHIV.	Conduct performance evaluation to ensure that information processes are harmonised and adequately integrated from the lowest level of reporting and health benefits are measured for PLHIV initiated on ART.

6.7 ASSUMPTIONS

According to Chinn & Kramer 2011, assumptions reflect the underlying values of the framework. It is assumed that:

- ✓ This framework informs decision making and policy formulations in the Khomas region. Consequently, through this harmonised proposed framework, the researcher envisions that this region will reach the Universal Targets on Non-Communicable diseases as proposed by the WHO (61) (*enabling environment*).
- ✓ The framework outlines the processes used to monitor the performance of cardiovascular disease-specific interventions by measuring the efficiency and effectiveness of such interventions (*sound data quality management practices*).
- ✓ The proposed framework contributes to more efficient use of data and resources by encouraging the use of standardised indicators and data collection methodologies that can be compared over time and between different geographical areas (*evidenced-based health outcomes*).

6.8 EVALUATION OF THE FRAMEWORK

The term **evaluation** is defined by Stern as any activity that throughout the planning and delivery of innovative programmes which enables those involved to make judgments about the starting assumptions, implementation processes, and outcomes of the innovation concerned (216).

The surveillance framework to track and predict health outcomes of cardiovascular diseases risks among PLHIV initiated on ART was developed under the guidance and supervision of the academic project supervisors and ICT experts. Periodic feedback and recommendations were provided which contributed to the finalisation of the framework. The framework was also evaluated by experts knowledgeable in the clinical management of CVDs and HIV/AIDS, surveillance and monitoring of health programmes, and ICT with a specific focus on machine learning. Both hard and soft copies of the framework were sent to these experts to familiarise themselves with the same. In this section, the researcher will discuss the evaluation of the surveillance framework. A print-screen copy of the surveillance data repository and the evaluation criteria were shared with six evaluators. Furthermore, the process of the framework development, the purpose, concepts, definitions, structure, and assumptions of the framework were presented virtually to the evaluators. Subsequently, the surveillance framework was evaluated using a tailor-made checklist for addressing common concerns for validation of research models, as recommended by Richey and Klein (171):

- Does the framework include all the necessary elements of sound data management practices (data collection, data collation, data analysis, reporting, and use)?
- To what extent is the framework usable to a wide range of settings?
- Is the use of the framework cost-effective?

6.8.1 Data management practices (data collection, data collation, data analysis, reporting, and use)

Compromise in any of the five data management practices can cause serious bottlenecks in terms of producing quality information that could contribute to desirable outcomes for PLHIV initiated on ART. A suggestion was made to include weight, height, blood pressure, and smoking history as stand-alone data elements on the interface to make the framework more user-friendly. In addition, it was advised that ‘duration on ART’ and ‘known side-effects of long-term use of ART’ also be added to the forms. These additional data elements will ensure targeted screening, capturing and extraction of CVDs risk factors among PLHIV initiated on ART will be enhanced.

6.8.2 Usability in a wide range of settings

Usability is defined by Schoeffel as “the effectiveness, efficiency, and satisfaction with which specific users can achieve a specific set of tasks in a particular environment”(2003). Additionally, the EHR Usability Task Force reasons that lack of usability has the potential of directly affecting clinical productivity, error rate, user fatigue, and user satisfaction (Belden, 2017). One evaluator proposed an additional form on the interface which indicating ‘admitted’ or not ‘admitted’. By adding the aforementioned variables will give a prediction of whether the patient is at risk or not at risk of CVDs. Besides, since the end-users are the health care workers who ought to ensure that the accurate data is captured at the patient level, the evaluation team regarded the surveillance and monitoring framework as usable and that it can be applied to various settings in the health fraternity.

6.8.3 Cost-effectiveness

The deployment of this framework requires the relevant infrastructure and off-grid internet connectivity. Therefore, this framework will piggy-back by tying in with already existing plans of the MoHSS which advocates for interoperability of critical patient management systems.

The evaluation team regarded the framework as cost-effective since the current interface of ePMS could be adjusted to insert output boxes that will enable the system to capture additional data elements. It was agreed with the evaluation team that there is a need to introduce a framework that is user-friendly, easy to use without necessarily investing in huge financial resources.

6.9 SUMMARY

This chapter presented the development, implementation, and evaluation of the surveillance framework to enhance the prediction and tracking of cardiovascular risk factor data collection, analysis, reporting, and use among PLHIV initiated in ART in public health facilities. The objectives and findings of the study outlined below informed the abovementioned processes:

- Lack of standardised or harmonised data collection and analysis efforts for CVDs risk factor data at the health facility level to ensure integrated routine measuring of CVDs health outcomes for PLHIV initiated on ART.
- Increased prevalence of health risk factors such as high blood pressure, obesity, smoking, and alcohol use among PLHIV initiated on ART.
- Missing and incomplete data that has a significant effect on accurate surveillance and monitoring of cardiovascular diseases among PLHIV initiated on ART.

Furthermore, in this chapter, the process of developing the surveillance framework, its objectives, the aim/purpose, and its description were discussed in detail. The conclusions drawn from the discussion of the findings were used as a foundation for developing forms in the java environment that informed the interface of the framework. Furthermore, this resulted in the development of a surveillance framework that enhances data collection, analysis, reporting and use of risk factors for cardiovascular diseases among PLHIV initiated on ART. The next chapter discusses the conclusion, justification, limitations, and recommendations.

CHAPTER 7

GUIDELINES FOR OPERATIONALISATION OF A SURVEILLANCE FRAMEWORK FOR TRACKING AND PREDICTING HEALTH OUTCOMES OF CVDS RISKS AMONG PLHIV INITIATED ON ART

7.1 INTRODUCTION

The previous chapter discussed the process and structure of the surveillance framework, its implementation as well as its evaluation. The guidelines for the operationalisation of the framework to track and predict health outcomes of cardiovascular diseases risks among PLHIV initiated on ART are described in this chapter. These guidelines have been developed to assist health data managers with the implementation of the surveillance framework at health facilities in the Khomas region. The development of the guidelines for operationalisation the surveillance framework was derived from the study findings as well as the conceptual framework that was developed and described in chapter 5.

7.2 GUIDELINES FOR ENHANCING THE TRACKING AND PREDICTION OF HEALTH OUTCOMES OF CVDS RISKS AT HEALTH FACILITIES IN KHOMAS REGION

7.2.1 Aim of implementation guidelines

The guidelines aim to provide the health data managers with knowledge and skill on how to enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART in health facilities.

7.2.2 Scope of the guidelines

These guidelines, which are set out practically, are intended for use by health data managers when planning and implementing a program of surveillance of cardiovascular diseases among PLHIV initiated on ART. The formulation of the guidelines borrowed ideas from UNICEF's *programme guidance for early life prevention of non-communicable diseases* (222); steps from WHO's *a guide to implementation research in the prevention and control of noncommunicable diseases* (121) and CDC's *Implementation Guide for Public Health Practitioners* (223). The guidelines, to operationalise the framework, are presented as recommendations based on the three interrelated components of Samuel Arthur's machine learning model, namely *identifying CVDs risk factors; monitoring calculated risks, and measuring health outcomes*. These core elements are intended to take place in an **enabling environment** which applied **sound data quality management practices** to ensure **evidenced-based health outcomes** for PLHIV initiated on ART.

7.2.3 Guiding principles

The guiding principles for the operationalisation of the framework were adopted from the National Multisectoral Strategic Plan For Prevention and Control of Non-Communicable Diseases in Namibia 2017/18 – 2021/22(39). These principles which will continue to inform the implementation of the surveillance framework are summarised as follows:

- **Human Rights Approach** will be adhered to at all times whereby no PLHIV initiated on ART, who is seeking for integrated CVDs health services will be denied access to such services, or will be discriminated against based on their race, colour, sex, language, religion, political or another opinion, national or social origin, property, birth or status, as enshrined in the Universal Declaration of Human Rights (224).
- **Equity-Based Approach** relays the creation of inclusive, equitable, and

economically productive services that will discourage marginalising the provision of interventions for CVDs among PLHIV initiated on ART whose health might be compromised due to the epidemiological transitioning of multimorbid conditions.

- **Universal Health Coverage** denotes that all PLHIV initiated on ART should have access; without discrimination, to nationally determined sets of comprehensive promotive, preventive, curative, and rehabilitative health care services.
- **Empowerment of People and Communities** inspires the enabling healthy supportive environments in communities to adopt a healthy lifestyle and thereby reduces modifiable CVDs risk factors through their involvement in advocacy, policy, planning, legislation, service provision, monitoring, research, and evaluation.
- **Multisectoral Action** by guaranteeing the participation of individuals, families, communities, line ministries and NGOs, FBOs, private sector, and bilateral development partners for the effective prevention and control of the non-communicable disease.
- **Evidence-Based Strategies** will support the providing of a comprehensive, affordable, culturally sensitive, and cost-effective patient and people at risk- and population-oriented approaches based on the latest scientific evidence and/or best practice.
- **Efficient Resource Utilisation** allows the providing of health promotive and preventive actions as well as continued primary health care and clinical services, based on available resources and infrastructure.
- **Integration** launches the providing of integrated comprehensive approaches towards reducing common risk factors of major NCDs including policymaking, capacity building, partnership, information dissemination, and implementation in all aspects.

7.2.4 Core elements for operationalising the surveillance framework.

The following core elements for operationalising such as identifying CVDs risk factors in an enabling environment; monitoring calculated risks through sound data management practices and measuring health outcomes are discussed in detail in the next sections:

7.2.4.1 CORE ELEMENT ONE: IDENTIFYING CVDS RISK FACTORS IN AN ENABLING ENVIRONMENT

Health data managers and implementers of this surveillance framework ought to first have an understanding of the background and the development process to ensure its successful implementation. This could be achieved by conducting a situational analysis, building strategic partnerships, and streamlining sustainability and scale-up strategies as outlined below:

Situation analysis and planning

Implementers are required to conduct a situational analysis that will ascertain an understanding of the structural attributes influencing the prevalence of CVDs, their risk factors, and challenges to circumventing their reduction. In this case, the assessment of needs seeks to understand the real situation and compare it to what would be more desirable in terms of enhancing the quality of life of PLHIV initiated on ART. Before conducting the situational analysis, planning such as developing appropriate data collection tools that will help with the identification of the CVDs risk factors and prompt diagnosis remains a critical aspect.

The situational assessment will also assist with the identification of the behavioural and environmental factors. The following tailor-made elements from the UNICEF guidelines on NCDs were adopted and included in the efforts to conduct a situational analysis:

- CVDs risk factors (e.g. tobacco and alcohol use among PLHIV initiated on ART) are disaggregated by socio-demographics such as age, sex, and marital status.

- existing laws, policies, regulations, sectoral and multi-sectoral plans relevant to NCD prevention.
- existing national and subnational capacities (e.g. multi-sectoral mechanisms; capacities of policymakers, health professionals, and education professionals);
- accessibility health facilities where an integrated continuum of health care is offered in a one-stop-shop approach.
- building an environment that heightens an understanding of social norms, knowledge, attitudes, and practices that contribute to high NCD burdens and their risk factors.

Strategic Partnerships

National health data managers are required to enhance multisectoral planning, implementation of the surveillance, and monitoring framework in collaboration with the relevant line ministries in Namibia. Creating and maintaining bi-lateral partnerships with development partners, non-governmental organisations (NGOs), civil society organisations (CSOs), community-based organisations (CBOs), and professional associations/institutions remains an important priority. Public-private partnerships also remain critical in the implementation of this framework. This is required for effective policy change. The formation of CVDs/HIV technical working groups that reports to the National NCDs Technical Committee ought to be established. These technical working groups will be responsible for facilitating dialogue, stocktaking and agenda-setting, and development of public policies for CVDs and HIV syndemics prevention and control at all levels of reporting.

Sustainability and scale-up strategies

Although the implementation of the surveillance framework comes with additional costs, consideration should be given to the fact that this framework will lead to a justifiable level of improved health-related quality of life for PLHIV initiated on ART. Therefore, this framework

will piggy-back of existing national health economic efforts that advocate for the integration of cost-effective noncommunicable disease interventions into the basic primary health care package with referral systems to all levels of care (39,126). The emphasis ought to be placed on scaling-up cost-effective high-impact interventions such as interventions to address behavioural risk factors, early detection, and long-term care of PLHIV initiated on ART affected by CVDs. However, it is common practice that policies, guiding documents and strategies can easily gather dust due to non-implementation, therefore, health data managers must be aware of factors that negate sustainability (121):

- not adapting intervention approaches to the local context
- resisting the introduction of new practices due to capacity constraints
- a lack of human resources
- intervention costs (and other economic factors)
- insufficient investment in implementation infrastructure (including in training, monitoring, and evaluation systems)
- staff recruitment and staff turnover
- lack of political will

The WHO proposes elements that will assist implementers to successfully sustain health interventions include:

- A well-thought-through tailor-made sustainability plan which includes aspects of long-term continuation scale-up strategy.
- Leadership engagement and political buy-in remain a key ingredient in the success of any health intervention.
- Strong advocacy and communication strategies.
- Advocating for formalised and standardised change management.

- Continuous capacity building and in-service training opportunities to keep health data managers abreast of the latest global developments.
- Simple and user-friendly interventions which are easy to understand by all health workers.

Lastly, scaling-up strategies should make provision of aspects that clarify the importance and role of diversification, especially in a resource-limited health facility.

CORE ELEMENT TWO: MONITORING CALCULATED RISKS THROUGH SOUND DATA QUALITY MANAGEMENT PRACTICES

The second core element facilitating the implementation of the surveillance framework will highlight aspects around monitoring, evaluation, and reporting as discussed below:

Monitoring & Reporting, Evaluation

The findings of the study revealed that there is limited documented information on the prevalence of CVDs risk factors and integrated measuring of health outcomes for PLHIV initiated on ART. Therefore, health data managers and implementers of this framework play a pivotal role in filling data gaps for monitoring, evaluation, and reporting.

Identification, development, and constant reviewing of internationally accepted indicators to track progress which is included in reporting at all levels are critical throughout the implementation of the surveillance framework. Such indicators quantify achievements (or levels of success) and guide future strategy and interventions of CVDs among PLHIV initiated on ART in Namibia. The proposed indicators were carefully selected based on the major study findings as outlined below:

- **Monitoring exposure of CVDs risk factors among PLHIV initiated on ART:**

- Age-standardised prevalence of raised blood pressure among adults aged 18+ years (defined as systolic blood pressure \geq 140 mmHg and/or diastolic blood pressure \geq 90 mmHg).
- Age-standardised prevalence of obesity and overweight among adults aged 18+ years.
- Age-standardised prevalence of current tobacco smoking among persons aged 15+ years.
- Total (recorded and unrecorded) alcohol per capita (15+ years old) consumption within a calendar year in liters of pure alcohol)
- Age-standardised prevalence of insufficiently active adults aged 18+ years (defined as less than 150 minutes of moderate-intensity activity per week, or equivalent).
- **Measuring health outcomes of CVDs risk factors among PLHIV initiated on ART:**
 - Proportion of CVDs health outcomes measured among PLHIV.
 - Retention in care (target $>$ 80%).
- **Handling or managing of risk factor data for CVDs among PLHIV initiated on ART:**
 - Improved health systems to ensure the handling and safeguarding of CVDs data and its risk factors among PLHIV.
- **Utilisation of CVD data for decision making among PLHIV initiated on ART:**
 - Proportion of evidence-based decisions taken to inform CVDs health service delivery among PLHIV.

In addition, the adoption and implementation of the surveillance and monitoring framework should go hand-in-hand with the identification of a functional M&E committee to provide

timely and tailored guidance. A key-person responsible for advocating the M&E agenda from this committee could be part of the existing national or regional M&E committee. The implementation of the framework should continuously be evaluated to determine how well the plan is being implemented, making timely recommendations as well as necessary adjustments or institute corrective actions whenever it is appropriate.

Data Management

Data management is an important function in the implementation of the framework. Therefore, implementers must adhere to sound data management practices which can be included in the data quality management plan. Once again, adequate planning will ensure that data is appropriately managed and used by relevant stakeholders. Six key data management process is highlighted below:

- **Source:** this refers to where the data originates e.g. primary or secondary data
- **Collection** of data involves obtaining data from the original source and transferring it into the paper or electronic tools/instruments from which it can be analysed and reported.
- **Collation:** refers to the aggregation of data into summarised formats (cleaning).
- **Analysis:** refers to how data is presented, and it enables data users to compare achievements against targets, program objectives, associate variables, predict relationships, and indicate confidence in results.
- **Reporting** relates to a compilation of descriptive information whereby raw data and information are presented as useful knowledge. Through this process implementers can be allowed to measure their progress made with the implementation of interventions, highlight problems or difficulties encountered as well as successes and lessons learnt during implementation.

- **Usage:** data dissemination and utilisation is encouraged to ensure timely data-driven decisions are made.

CORE ELEMENT THREE: MEASURING HEALTH OUTCOMES TO ENSURE IMPROVED EVIDENCED BASED HEALTH OUTCOMES

Adopting health-related behaviours that will guarantee an improved quality of life of PLHIV initiated on ART is not always easily measured. However, using the modified tools developed under the first element will help to quantify achievements (or levels of success) and to guide future strategy and interventions pertaining CVDs in Namibia (as highlighted in the previous chapter). Existing tools currently in use at MoHSS could be amended to include the capturing of critical indicators as highlighted above.

7.3 SUMMARY

This chapter presented the guidelines for the development, description, and evaluation of the framework. The conclusions drawn from the discussion of the findings were used as a foundation for constructing a robust surveillance framework to enhance tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART. The next chapter discusses the conclusion, justification, limitations, and recommendations.

CHAPTER 8

CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS OF THE STUDY

8.1 INTRODUCTION

The previous chapter presented the implementation and evaluation of the surveillance framework for health facilities. In this chapter, the overall aim and objectives of the study are revisited to ensure that they have been achieved. In addition, chapter 8 provides a synopsis of the main findings of the study. Furthermore, conclusions, limitations, and recommendations that emerged from the study findings following the situational analysis, development of the conceptual and surveillance framework, are discussed. The unique contributions to the body of knowledge are also highlighted.

8.2 CONCLUSIONS OF THE STUDY

This study comprised four (4) sequential research phases. All four phases informed the development, implementation, and evaluation of the surveillance framework. The objectives were achieved through a mixed-method approach whereby the qualitative and quantitative, exploratory, descriptive, and contextual methods were used sequentially. The main findings of the study are presented and discussed in Chapter 4.

The purpose of this study was to develop and describe a novel surveillance framework that would enhance the tracking and prediction of health outcomes of CVDs risks amongst PLHIV initiated on ART in the Khomas region. The study findings derived from the objectives translated into the development of the conceptual framework and the surveillance framework that enhances the tracking and prediction of health outcomes of CVDs risks amongst PLHIV

initiated on ART in the Khomas region. The following objectives were used to achieve the overall aim of the study:

8.2.1 Phase 1: Situational analysis of the current practices of routine tracking (data collection, data analysis, reporting, and data quality) of CVDs risk factors among PLHIV initiated on ART.

This phase adopted a qualitative, exploratory, descriptive, and contextual design and quantitative, descriptive sequential design to achieve the following specific objectives:

Objective 1a: To explore and describe health workers' perception of the data management practices of risk factors for cardiovascular diseases among PLHIV initiated on ART (Phase I).

A qualitative, phenomenological study design was employed. Thirteen key informants selected purposively were interviewed. Data were transcribed verbatim, exported to ATLAS.ti, and analysed by generating themes, quotes, and networks. In addition, a summative content analysis was conducted. Five prominent themes related to data management practices regarding CVDs and its risk factors in the context of HIV were identified at the targeted health facilities. The study findings indicated that routine data collection efforts to determine the prevalence of risk factors for CVDs were routinely done for all ART clients at the health facilities. However, existing guidelines are not institutionalised, tailor-made, and are outdated to address current issues of CVDs among PLHIV.

The findings of the phenomenological situational analysis informed the quantitative data collection process for objective 1b and 1c as summarised below:

Objective 1b: To assess the health risk factors associated with CVDs among PLHIV on ART(Phase I).

An assessment of risk factors of CVDs among PLHIV was also determined through a retrospective cross-sectional quantitative descriptive study design. Client records were reviewed, and data on traditional health risk factors for CVDs such as blood pressure, height, weight, smoking, and alcohol consumption were extracted from the individual patient care booklets (PCB) at the targeted health facilities. In addition, socio-demographic data such as age and sex were obtained from the electronic patient monitoring system (ePMS) since the inception of the programme until 2017 from the targeted health facilities in the Khomas region.

All data were entered into MS Excel spreadsheet, exported and analysed in SPSS version 25 using descriptive statistics with bivariate and multivariate analysis. The study findings showed that high blood pressure, obesity, smoking, and alcohol use are greatly prevalent among PLHIV, particularly males. With the current epidemiological transition of HIV and cardiovascular diseases, the need to advocate for systems that provide accurate information, early screening with subsequent treatment for PLHIV in the Khomas region, was part of the concluding remarks by this study.

Objective 1c: To describe patterns of data availability and completeness of CVDs risk factors' data for PLHIV initiated on ART(Phase I).

Patterns of data availability and completeness of risk factors for cardiovascular diseases enrolled at the ART programme at the selected health facilities in the Khomas region: A retrospective, cross-sectional, quantitative study design was used to assess the aforementioned data management practices. A similar process was followed as above whereby a total of 529 client records were reviewed and data on traditional health risk factors for CVDs such as blood

pressure, height, weight, smoking, and alcohol consumption were extracted from the Individual patient care booklets (PCB) at the targeted health facilities. In addition, data elements such as marital status, date of birth, age, ART start year; total average of follow-up days; and total average of visits per year were reviewed to determine data availability and completeness, thus measuring client retention in ePMS. From these records, 72.8% of the records indicate that PLHIV is at risk due to inconsistent or missing data in both urban and rural sites.

Data were entered into MS Excel spreadsheet, exported and analysed in SPSS version 25 using descriptive statistics with bivariate and multivariate analysis. It was concluded that data collection efforts to determine the prevalence of health risk factors for CVDs are routinely made for all ART clients at the health facilities. However, incomplete, inconsistent, and inaccurate data recordings were prevalent at most of the targeted health facilities.

8.2.2 Phase 2: Construction of a conceptual framework

Objective 2: To develop a conceptual framework for tracking of health outcomes of CVDs risk factors among PLHIV initiated on ART from the findings of the study

The conceptual framework was developed from the findings of the situational analysis. The syndemic theory, the six elements of the PHST (trigger, problem formulation, surveillance planning, surveillance implementation, and information generation and audit), and, Donabedian's three elements which comprise of the structure, process, and outcomes were fused into together with the findings from the study to construct and develop the conceptual framework. These interrelated elements were discussed in relation to the central concepts such as ***enabling environment, sound data quality management practices, and evidenced-based health outcomes*** also contributed to the development of the framework to enhance the prediction and tracking of health outcomes of CVDs risk among PLHIV initiated on ART. The

conceptual framework was used as a guide for synthesising constructs that served as a foundation for developing a robust surveillance and monitoring framework for prediction and tracking health outcomes of CVDs risk among PLHIV initiated on ART in the Khomas region. This objective was achieved through the development of a conceptual framework from the findings of the study.

8.2.3 Phase 3: Construction and description of the framework and prototype software to facilitate its implementation.

Objective 3: to develop and describe the novel surveillance framework to track and predict health outcomes of cardiovascular diseases risks among PLHIV initiated on ART in Khomas region.

The proposed surveillance framework was developed to enhance the tracking and prediction of health outcomes of CVDs risks among PLHIV initiated on ART at the health facilities in the Khomas region. The PHST of Allaki et al., Donabedian's SPO model, and Arthur Samuel's machine learning model were adopted to develop the framework focussing on surveillance of risks for CVDs; and monitor calculated risks, and evaluated measured CVDs outcomes among PLHIV initiated on ART.

The set of rules of the machine learning model was consistent with the findings of Firdaus, Hassan, and Kaur who used similar models to identify, evaluate, and contrast Type 2 Diabetes Mellitus performance through electronic health records (140). Similarly, breast cancer risk, its prediction, and diagnosis were also determined with the use of machine learning algorithms by Mousannif, Moatassime, and Noel (79). The researcher concluded that the supervised learning models are ideal for prediction, diagnosis, prognosis, and surveillance of CVDs and its risk factors at the health facilities in the Khomas region. The objective to develop a surveillance

framework was achieved by adopting a classification algorithm, one of the popular applications of supervised learning invented by Arthur Samuel (140,215,225).

8.2.4 Phase 4: Operationalisation of the framework

Objective 4: To develop the guidelines to operationalise the novel surveillance framework.

This objective was achieved by developing guidelines for operationalising the framework that would enhance the prediction and tracking of health outcomes of CVDs risks among PLHIV initiated on ART. These guidelines were developed to address the problem of fragmented data management practices of CVDs preventative care among PHHIV initiated on ART. The guidelines outline the aim, scope, guiding principles, and the core elements for operationalising the surveillance and monitoring framework such as identifying CVDs risk in an enabling environment; monitoring calculated risks through sound data quality management practices and finally measuring health outcomes to ensure improved evidenced-based health outcomes for PLHIV initiated on ART.

8.3 UNIQUE CONTRIBUTIONS TO THE BODY OF KNOWLEDGE

The researcher of this study posits that the study contributes to the body of scientific knowledge in the public health arena positively. For clarification purposes, the original contribution is summarised.

- The qualitative findings revealed current practices for recording patient data, and highlights the lack of integration of data sources, both for effective patient-centred clinical management and for population surveillance which informed the quantitative data extraction and subsequently, the development of the surveillance framework to facilitate the implementation of the framework.

- Currently, the National Multisectoral Strategic Plan for Prevention and Control of Non-Communicable Diseases (NCDs) in Namibia 2017/18 – 2021/22 advocates for periodic

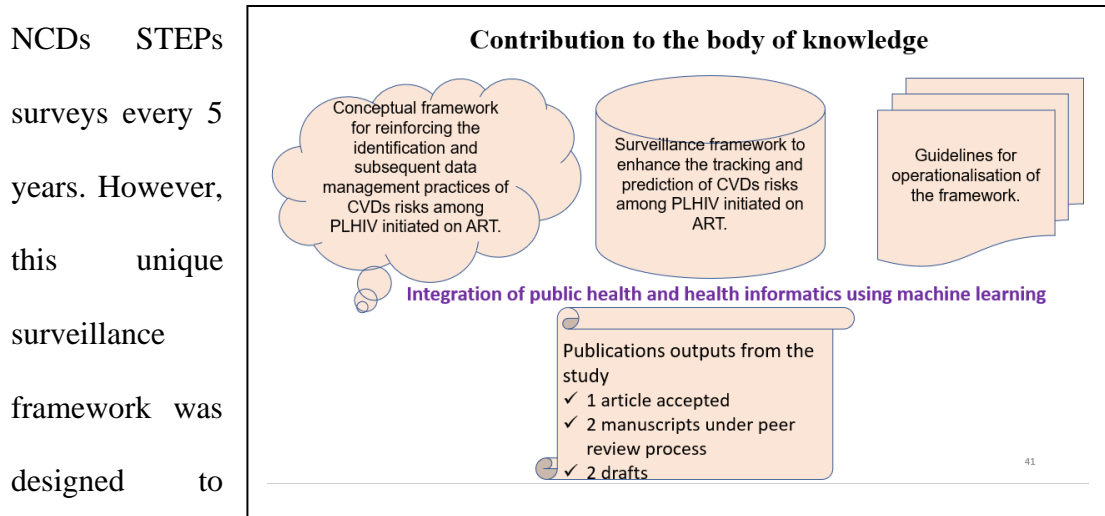


Figure 8.1: Output of researcher’s contribution (Mahalie, 2019)

routine tracking of health outcomes of CVDs risk factors amongst PLHIV initiated on ART in the Khomas region.

- The conceptual framework was considered a unique contribution to the body of knowledge in public health since health care workers and other scholars could utilise it as a reference document or baseline for future scientific efforts geared towards prevention and control of CVDs among PLHIV initiated on ART.
- The development of the surveillance framework involved the rapidly evolving concepts of the ‘internet-of-things’ whereby machine learning through complex algorithms were used to predict risks of CVDs and, measuring health outcomes, and institute immediate alternative health care to PLHIV initiated on ART. The adoption of this framework may result in the provision of integrated healthcare services to PLHIV, which could lead to better health outcomes. Additionally, the institutionalising of integrated CVDs care to PLHIV at all levels of health service delivery will be an added advantage. The framework also includes a feedback

mechanism that includes quarterly action-oriented data review sessions at the health facility level.

- Guidelines for the operationalisation of the surveillance and monitoring framework was developed.
- Through the outcome of this study health policymakers and data, managers can create an enabling environment for achieving the WHO NCD targets by 2025.

8.4 LIMITATIONS

Few limitations that might have influenced the results of the study are highlighted below.

A project of this magnitude needs political buy-in, champions to propel it forward, adequate staff and resources, and a reasonable timeframe for implementation and validation. However, permission was sought from the Executive Director of the Ministry of Health and Social Services to develop the surveillance and monitoring framework and open communication with authorities and the development of a costed activity plan by the researcher countered for the gaps.

Due to financial constraints, only one health district could be involved in this study which makes generalizing the study results challenging. However, since the Khomas region was used as a pilot region and health district for the roll-out of the Quantum database for managing routine data of those patients who are initiated on ART, replication to other regions could be a worthwhile option to consider.

The challenge of getting the right datasets for disease prediction is very important. The study findings revealed that missing and incomplete CVDs risk factor data compromised the quality of care provided to PLHIV initiated on ART. Therefore, an integrated approach to ensuring

better health outcomes was introduced. For example, the researcher invested considerable time in the development of specific algorithms which also required testing to ensure its robustness.

Although the researcher wanted to conduct a census of all the regions, the study population and sample of the participants in this study were limited to the health facilities in the Khomas region. The sample in this study involved various healthcare workers and data managers in the public health facilities in the Khomas region (rural and urban); however, the researcher excluded private health care facilities that might have had a meaningful contribution from a different angle.

The study covered large numbers of various data elements; however, not all of these elements could be analysed in depth. Additional research and in-depth analysis of these data elements might be useful for the detailed measuring of health outcomes of all non-communicable diseases.

Furthermore, the surveillance framework has only been tested in simulation; hence its actual practicality is not known however the actual implementation will be advocated for as a post-doctoral study. Lastly, the critical reflection of this framework was done according to the guidance provided by Richey and Klein (2014) to help clarify how well it relates to theory, research, or practice.

8.5 RECOMMENDATIONS

The following recommendations are made, considering the findings of this study, specifically to the Ministry of Health and Social Services (at policymaking level, management level, and implementation level), the public health domain as well as future research.

8.2.1 Recommendation to the Ministry of Health and Social Services (Policymaking level):

The researcher recommends that MoHSS at the national level ensure the integration of this framework into standardised /institutionalised strategies, policies, and guidelines to facilitate regular integrated CVDs risk factor surveillance among PLHIV initiated on ART at PHC facilities.

In order to continuously monitor national progress, evidence-based programme planning should ultimately be streamlined at national, regional, and district levels. By so doing, the platform for advocacy, policy development, and coordinated action will be provided to reinforce political commitment and map the progress on the prevention and control of CVDs and other NCDs. Therefore, the researcher recommends that MoHSS continue to provide an enabling environment that will strengthen technical and institutional capacity and speed up the integration of this surveillance and monitoring framework for tracking and linking CVDs health outcomes among PLHIV initiated on ART into existing efforts at PHC facilities.

The recently launched National Multisectoral Strategic Plan for Prevention and Control of Non-Communicable Diseases (NCDs) in Namibia 2017/18 – 2021/22 was developed for the prevention and control of NCDs in the country, reducing exposure to risk factors, and creating an enabling environment for health systems for line ministries and other stakeholders to reach the national NCD targets by 2025. This high-level strategic document was developed to avert

the high burden of mortality, disability, and economic loss related to NCDs (1,39). However, findings from the in-depth interviews revealed that the healthcare workers are generally ignorant or rather not aware of the existence of the national strategy on NCDs. Moreover, there has been no robust surveillance framework to identify data sets and integrate NCD surveillance into national health information systems while undertaking periodic data collection on the behavioural and metabolic risk factors (harmful use of alcohol, physical inactivity, tobacco use, unhealthy diet, overweight and obesity, raised blood pressure, raised blood glucose, and hyperlipidemia) among PLHIV initiated on ART. Therefore, the researcher recommends that the policymakers consider the integration of this framework in their planning and advocate for its use among PLHIV initiated on ART to circumvent the effects of CVDs.

Currently, the General Hypertension Guidelines (2005) is outdated, and very few health workers are using it as a reference document although they seem to have substantive knowledge on the management of hypertension among the general population. Therefore, the researcher recommends that policymakers expedite the finalisation and integration of the World Health Organization Package of Essential Non-Communicable Disease Interventions (WHO PEN) for Primary Health Care in Low-Resource Settings into all PHC programs. The researcher also recommends that critical aspects of the surveillance framework for tracking and linking CVDs outcomes to PLHIV be considered and incorporated into the final document to ensure integrated service delivery.

Lastly, the agenda of CVDs is not explicit in the Ministry of Health and Social Services Strategic Plan 2017/2018 – 2021/2022 and the National Health Policy Framework 2010-2020. The researcher recommends that the stipulations of the newly developed surveillance framework be incorporated when the abovementioned documents are revised in 2020 and 2022.

8.2.2 Recommendation for the health facilities management (Management and operational level):

The researcher recommends that health data managers ensure that data review sessions are comprehensive and inclusive of CVDs and other NCDs for PLHIV initiated on ART at the health facility level.

Data review, feedback, and action planning are critical in determining the prevalence and burden of CVDs and systematically assess progress in the use and impact of subsequent health interventions for PLHIV. Interestingly, the findings of the study revealed that although data review sessions are happening on an ad-hoc basis, such efforts are mostly geared towards communicable diseases. Therefore, the researcher recommends that health care managers conduct quarterly data review sessions coupled with action planning, to ensure that sound data management practices are adhered to and later on result in the availability of high-quality data on CVDs and its risk factors. This will also create an opportunity for all health facilities to come together and discuss best practices, see what and how they are doing in terms of health service delivery data management practices and what could be replicated. Furthermore, the researcher recommends that champions at the operational level continuously advocate for the use of CVDs risk factor data at existing platforms through data reviews and action planning sessions.

8.2.3 Recommendation for future research

- For future research, the researcher recommends that the same study be replicated in other health districts nation-wide to determine similarities in outcomes and if possible, adopt the surveillance framework without necessarily reinventing the wheel.
- Future research in the area of machine learning and its various optimisation techniques in disease datasets that can efficiently visualise and analyse risk factor data for all NCDs. Such a study will simultaneously direct future work on sustainability.

8.6 SUMMARY

Through this research, a surveillance framework that enhances the tracking and prediction of health outcomes of CVDs risk factors amongst PLHIV initiated on ART in the Khomas region was developed. The study findings are validated by the conclusions, recommendations, and limitations that demonstrate the feasibility of methods and evaluation of the framework that was made to respond to the initial purpose of the study. This chapter also highlights the unique contributions made through this robust study to the body of knowledge in the social science arena locally, regionally, and globally.

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LIST OF ANNEXURES

ANNEXURE 1: PERMISSION LETTER FROM UNAM: PGSC

CENTRE FOR POSTGRADUATE STUDIES

University of Namibia, Private Bag 13301, Windhoek, Namibia
340 Mandume Ndemufayo Avenue, Pioneers Park
☎ +264 61 206 3275/4662; Fax +264 61 206 3290; URL: <http://www.unam.edu.na>



RESEARCH PERMISSION LETTER

Student Name: R Mahalie

Student number: 9218602

Programme: PHD in Public Health

Approved research title: A surveillance mechanism to enhance the integration of cardiovascular disease into existing HIV platforms in Namibia.

TO WHOM IT MAY CONCERN

I hereby confirm that the above mentioned student is registered at the University of Namibia for the programme indicated. The proposed study met all the requirements as stipulated in the University guidelines and has been approved by the relevant committees.

The proposal adheres to ethical principles as per attached Ethical Clearance Certificate. Permission is hereby granted to carry out the research as described in the approved proposal.

Best Regards

A handwritten signature in black ink, appearing to read 'Marius Hedimbi', is written over a horizontal dashed line.

Name: Dr Marius Hedimbi

Director: Centre for Postgraduate Studies

Tel: +264 61 2063275

E-mail: directorpgs@unam.na

27/06/2017

Date

Centre for Postgraduate Studies
Office of the Director
2017 -06- 27
University of Namibia
UNAM

ANNEXURE 2: ETHICAL CLEARANCE CERTIFICATE FROM MOHSS



REPUBLIC OF NAMIBIA

Ministry of Health and Social Services

Private Bag 13198
Windhoek
Namibia

Ministerial Building
Harvey Street
Windhoek

Tel: 061 – 2032150
Fax: 061 – 222558
Email: shimenghipangelwa71@gmail.com

OFFICE OF THE PERMANENT SECRETARY

Ref: 17/3/3 RM

Enquiries: Mr. J. Nghipangelwa

Date: 14 November 2017

Mrs. Roswitha Mahalie
Namibia University of Science and Technology
Windhoek, Namibia

Dear Mrs. Mahalie

Re: Surveillance mechanism to enhance the integration of cardiovascular disease into existing HIV platforms in Namibia

1. Reference is made to your application to conduct the above-mentioned study.
2. The proposal has been evaluated and found to have merit.
3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**
 - 3.1 The data to be collected must only be used for academic purposes;
 - 3.2 No other data should be collected other than the data stated in the proposal;
 - 3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects' should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;
 - 3.4 A quarterly report to be submitted to the Ministry's Research Unit;
 - 3.5 Preliminary findings to be submitted upon completion of the study;

3.6 Final report to be submitted upon completion of the study;

3.7 Separate permission should be sought from the Ministry of Health and Social Services for the publication of the findings.

Yours sincerely,



Andreas Mwoombola (D)
Permanent Secretary



**ANNEXURE 3: PERMISSION LETTER FROM KHOMAS HEALTH
DIRECTORATE**

9-0/0001



REPUBLIC OF NAMIBIA
Ministry of Health and Social Services

Private Bag 13322
Windhoek
Namibia
Enq: Mr. B. Isaacs

Khomas Region Directorate
Florence Nightingale Street
Windhoek

Tel: 061 - 2035011
Fax: 061 - 235997

Ref: S4/9

Date: 7 December 2018

OFFICE OF THE DIRECTOR

STAFF MATTER: CONFIDENTIAL

**MRS. ROSWITHA MAHALIE
NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY
WINDHOEK**

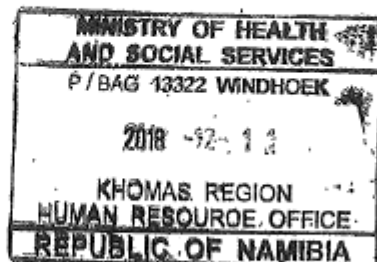
Dear Mrs. Mahalie

I have pleasure to inform you that as per Permanent Secretary's approval, permission is granted for you to conduct a study on investigation on "Surveillance mechanism to enhance the integration of cardiovascular disease into existing HIV platforms in Namibia. You are permitted to visit the following facilities and offices; Katutura Health Centre, Khomasdal Health Centre, Robert Mugabe Clinic, Groot Aub Clinic, Khomas Regional Office and Windhoek District Office from the 11 December until 28 February 2019.

The office wishes you success with your research.

Yours sincerely

**MS. ELIZABETH MUREMI
DIRECTOR: KHOMAS REGION**



ANNEXURE 4: PERMISSION LETTER FROM OFFICE OF THE MEDICAL SUPERINTENDENT KATUTURA INTERMEDIATE HOSPITAL



Republic of Namibia

Ministry of Health and Social Services

Private Bag 13215
WINDHOEK
Namibia

Intermediate Hospital Katutura
Independence Avenue
WINDHOEK

Telephone (061) 203 4004/5
Telefax (061) 222706

Enquiries: Dr. F. M. Shiweda

Date: 18 July 2018

OFFICE OF THE MEDICAL SUPERINTENDENT

Mrs. Roswitha Mahalle
Namibia University of Science and Technology
Windhoek, Namibia

Dear Mrs. R. Mahalie

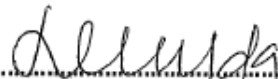
RE: SURVEILLANCE MECHANISM TO ENHANCE THE INTERGRATION OF
CARDIOVASCULAR DISEASE INTO EXISTING HIV PLATFORMS IN NAMIBIA

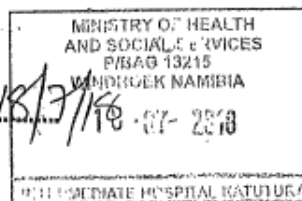
The above mentioned subject refers:

This office hereby grants you permission to do a research on surveillance mechanism to enhance the integration of cardiovascular disease into existing HIV platforms in at Katutura State Hospital, Khomas Region, MoHSS.

Thank you

Yours in health,


DR. F. M. SHIWEDA
CHIEF MEDICAL OFFICER



**ANNEXURE 5: CONSENT FORM FOR KEY INFORMANTS: INFORMATION
LEAFLET
INFORMED CONSENT**

Study Title: A surveillance mechanism to enhance the integration of cardiovascular disease programs into existing HIV platforms in Namibia.

Researcher: Roswitha Mahalie, Student at the University of Namibia, Windhoek, Namibia; rqmahalie@gmail.com; +264 813044166 (m).

Supervisors: Dr Penehafo Angula HOD Community and Global Health, School of Public Health, Oshakati Campus, University of Namibia, pangula@unam.na; +264 65 223 2253 (w). Dr Kabwebwe Honoré Mitonga, Dean: School of Public Health, Oshakati Campus, University of Namibia; +264 65 223 2253 (w). Prof Olanrewaju Oladimeji, Adjunct Professor, School of Public Health, Oshakati Campus, University of Namibia

Dear Participant,

I, Roswitha Mahalie, a PhD student at the University of Namibia (UNAM), School of Public Health, hereby invite you to participate in a research project entitled: Development of a surveillance and monitoring framework to enhance the integration of cardiovascular disease programs into existing HIV platforms in Namibia.

I am conducting this study as part of the larger study on developing a surveillance and monitoring framework to enhance the integration of cardiovascular disease programs into existing HIV platforms. The study will be conducted in the Khomas health district.

An interview guide comprising one main question and supplementary questions will be used to identify and explore current data management activities for CVDs including available resources useful for providing integrated services to PLHIV.

The study will provide information that will facilitate the development of a surveillance mechanism to ensure integrated services delivery and data management of CVDs amongst PLHIV. Please be informed that the individual responses you will provide will be kept confidential. No personal details or cross-reference will be made to you in the final report or subsequent publications that will link you to the outcome of this study. If you choose to participate, you may withdraw at any time without any penalty or undesirable consequences. Please note that there will be no monetary gain for participating in this research project.

Sincerely,

Researcher's signature

CERTIFICATE OF ASSENT

Study Title: A surveillance mechanism to enhance the integration of cardiovascular disease programs into existing HIV platforms in Namibia.

Researcher: Roswitha Mahalie, Student at the University of Namibia, Windhoek, Namibia; rqmahalie@gmail.com; +264 813044166 (m).

Supervisors: Dr Penehafo Angula HOD Community and Global Health, School of Public Health, Oshakati Campus, University of Namibia, pangula@unam.na.; +264 65 223 2253 (w).
Dr Kabwebwe Honoré Mitonga, Dean: School of Public Health, Oshakati Campus, University of Namibia; +264 65 223 2253 (w). Prof Olanrewaju Oladimeji, Adjunct Professor, School of Public Health, Oshakati Campus, University of Namibia

I _____ (initials of participant) hereby give consent to participate in the study entitled ‘development of a surveillance framework to enhance CVDs integration into existing HIV programs. I agree to be interviewed and understand that my identity will be kept confidential, that I can withdraw any time during the data collection process. I agree that responses provided by me can be used in the development of a surveillance mechanism by the researcher.

Signature.....(respondent)

Date.....

Thumb print.....(Only for those who are cannot read/write)

Witness.....Date.....

ANNEXURE 6: KEY INFORMANT INTERVIEW GUIDE

Good afternoon/morning, I am Roswitha Mahalie, conducting research to find out more about data capturing and use of CVDs risk factors amongst PLHIV. I was given permission by the PS of MoHSS, the regional Director of Khomas region, and the University of Namibia to continue with research (permission letters shown to the interviewee). Thank you for availing yourself by giving permission to be interviewed for the next 15-30 minutes. All information will be treated in the strictest confidence, responses are anonymous, and you are free to withdraw from the study at any given time without any implications against you as an individual. May I ask you a few questions?

Sex: Job category: Years of experience as healthcare worker:

- **Main question**

- What are the perceptions of health workers on the current data management practices useful for providing integrated CVD-related preventive care services to PLHIV?

- **Supplementary questions (probing questions)**

- Describe the data management activities you have been involved with? If yes, were these data management activities useful for providing integrated services to PLHIV; If no explain why he/she was not involved.
- Do you currently collect data to improve screening for CVD risk factors and improve practices for CVD-related preventive care services among clients enrolled for ART? If Yes, how do you collect the data?

- Where do you enter the data? What do you do with the data after collection?
Mention at least 3 risk factors that are currently monitored.
- Can you describe how you monitor these risk factors? If No: Are there specific reasons why screening for CVD risk factors is not taking place?
- Do you use the data captured for decision making and/or improvement of health services provided to PLHIV at your facility? If yes/no: understanding the reasons for using/not using health information for decision making.
- How are the prioritisation and use of CVDs related information among PLHIV related information in decision making is supported in terms of strategies, guidelines, and policies?
- What is your opinion on the possibility of developing a user-friendly, integrated surveillance framework to measure and manage CVDs risk factors among clients enrolled in the ART program? What do you think would need to be done to adequately address any issues identified?

ANNEXURE 7: TRANSCRIPTION OF IN-DEPTH INTERVIEWS

Transcript: Key informant interviews: Khomas Health District region

Interview 1

Researcher: Good afternoon Dx, as per our telephonic conversation, I am Roswitha Mahalie conducting a study on looking ways how to develop a surveillance and M&E framework for CVDs risk factor data and its subsequent use. Whatever we are discussing here will only be used for academic purposes. Thank you for making time in your busy schedule to be interviewed today.

Respondent A: You are welcome. I hope I will be able to respond to your questions.

Researcher: Kindly tell me more about the Quality Improvement projects you are working on?

Respondent A: We have rolled out the NAMPROPA project for a period of 12 months in piloted regions i.e. Khomas, Ohangwena and Zambezi. The project is a QI collaborative which focusses on improving retention, viral load monitoring, viral load suppression, and hypertension screening and treatment among PLHIV on ART in Namibia. The primary focus is therefore on patient flow, retention and treatment.

Researcher: I know you are not specifically responsible for collecting this data but what happens with the data after it is recorded?

Respondent A: I am basically focusing on ensuring that the aforementioned indicators are monitored and that health workers have an understanding of the nitty-gritties of these indicators.

Researcher: Were you involved in any action plans that were developed based on the outcomes of the data collected from the various indicators

Respondent A: The actions plans were done at the conclusion of each learning session. Data were collected, analyzed and reported on a monthly basis to track the results of their interventions. Unfortunately, I don't have copies of action plans.

Researcher: where can I get information on the data that is collected?

Respondent A: However, M&E people are responsible for capturing and reporting the data. In any case the data goes straight to the Ministry of Health and Social Services. It is better to ask detailed information from the MoHSS since we are only implementing partners. The first phase of the project is ending.

Researcher: hmmm....do you want to talk about some challenges you've experienced during the implementation of the project

Respondent A: I think to biggest challenge is that the health workers considered this project as extra work or added responsibilities. There is currently a lot of staff turnover happening especially amongst the nursesyeah.....

Researcher: OraaitI see.....staff turnover seems to be an increasing these days.....

Respondent A: yeah, in terms of the data flow and everything I think you should talk to the M&E folks.

Researcher: Thank you very much for your valuable time.
.....

Interview 2

Researcher: Good afternoon sir, I am Roswitha Mahalie, as I have introduced myself previously when we made the appointment. As indicated my study focus on the development of a surveillance and M&E framework for CVDs risk factor data and its subsequent use. Thank

you for availing yourself by giving permission to be interviewed for the next 15-30 minutes. All information will be treated in the strictest confidence, responses are anonymous, and you are free to withdraw from the study at any given time without any implications against you as an individual.

Respondent B: It is fine. Let's go ahead.

Researcher: Please tell me what your current responsibilities entails

Respondent B: My responsibilities range from health education, taking parameters, screening dispensing drawing blood, managerial responsibilities, overall in-charge, administration: clients, staff and other managers. I am also involved in data management activities such as compiling reports for QA projects for:

- HIVQual: IPT initiation and completion, Papsmear
- NAMPROPA: LTFU, Viral load suppression, BP screening and treatment
- NAMLIFE: Recently introduced. Viral load monitoring and suppression (15-24 years), IPT initiation, newly diagnosed (same day and 7 days)

Researcher: How often do you compile these reports

Respondent B: Reports are compiled on a monthly basis. However, NAMPROPA reports for HPT& Treatment is done every Friday and the summarized reports are compiled at the end of each month and send to the Directorate of Special Programs (DSP) through the clinical and nurse mentor.

Researcher: So only the NAMPROPA reports are sent to DSP?

Respondent B: No, we also sent the reports captured and generated in the ePMS database to Mr. G at DSP.

Researcher: Do you perhaps know what happens to the NAMPROPA reports at DSP?

Respondent B: I participated in one article writing that was presented at a conference in SA, our site was used as an example of integrating HPT into ART services, but I am not so sure what is currently happening with the QI reports and how the data is managed at DSP. What I know is that we met our target for LTFU, Viral load suppression and BP screening.

Researcher:...and what happened to the reports generated from the ePMS?

Respondent B: The data entry clerk sends it to DSP, and they have data review meetings, but the focus is on HIV related indicators. We have never done a data review meeting with DSP where we have only discussed and analysed parameters collected, captured and entered in ePMS to identify cardiovascular diseases.

Researcher: Ok. That is interesting. Do you collect specific CVDs risk factor data?

Respondent B: we routinely collect the BMI which is done at every patient visit where we take the weight and height of a client for further interventions. Interventions are only focused on malnourished patients. However, records are only available of those clients who are malnourished and who needs to be put on the food supplements such as the nuts. We don't monitor clients who are obese although the parameters are taken.

Researcher: where do you capture the BMI data?

Respondent B: BMI data is not captured in a system. We record this data in a normal book

Researcher: have you ever thought of analysing the data to see how many clients have issues with BMI?

Respondent B: hmmm...interesting but unfortunately, we haven't done that before at this site.

Researcher: is there a specific reason why it was never done?

Respondent B: I don't know of a specific reason, but it is just that it was never requested, or we never thought of it.

Researcher: what other parameters do you do that is linked to CVDs and tell me what you do with this data

Respondent B: Blood pressure is also taken. The first reading is captured in ePMS but all subsequent readings are entered and kept in the parameters book. The ePMS database does not have a place to enter blood pressure readings.

Researcher: now what happens when you find a client with a high blood pressure reading?

Respondent B: Patients are told to return for 3 consecutive days to monitor their blood pressure. Once the reading remains high the doctor will put the patient on hypertensive treatment.

Researcher: Ok. Now are you aware of patients who were diagnosed with HPT after initiation of ART.

Respondent B: Yes, we do have such patients. But I can't confidently say yes that there is a link between ART and HPT. This data is available with the NAMPROPA project

Researcher: any other CVDs risk factors that are monitored....

Respondent B: Cholesterol levels are not taken. As a matter of fact, no cholesterol screening is done and it's not appearing in any system. In addition, smoking and alcohol is not done often. We usually ask this question when patient is initiated on ART. Blood samples that is taken are CD4, viral load, HB, Hepatitis and creatinine. Of late a health information form is pasted in every patient file where this information is collected at every visit and recorded in the patient file.

Researcher: What do you do with the smoking and alcohol history of a patient?

Respondent B: this data is kept in the patient file, but it is not analysed. It is only used when the patient viral load is high.

Researcher: Do you think this data is useful.

Respondent B: Yes, it might be useful if its channeled into a proper system. No system is focusing on alcohol usage and subsequent interventions. But anyway, we will be having a workshop next week to review the patient care booklet.

Researcher: ok, are you attending the workshop and what are the specific changes will you be proposing to the patient care booklet?

Respondent B: yes, you see the patient care booklet is used to inform and guides information that is needed in terms of patient care and this information is afterwards captured into the book and the system called ePMS. For example, the clinic used to monitor CD4 count in the past but currently our focus is on monitoring viral load this information should be captured and the rest of the other parameters we are using to monitor clients on ART. This information should be captured in the system and also to help us to make decisions that will help the patient to maintain a healthy lifestyle.

Respondent B: So, you are using the data captured for the viral load? Why do you think using data is so critical?

Researcher: data that are mostly used are from the QI projects as mentioned earlier. In my books, data is used to encourage staff to improve service delivery, inform what to give in terms of health education and it can also be used as teaching tools for the different number of students who are always coming to look for information or are placed during their internships. We usually have nursing students on a monthly basis, those for doing counseling come for 3 months and 6 months and other interns rotate on a 2-weekly basis.

Researcher: How often do you get feedback from your clients and sort of feedback do you normally get?

Respondent B: there is a client's committee that provides constructive feedback in the suggestion boxes. This informs us what they think of the way we are delivering services and any other suggestions. It is only when you hear from the horse's mouth that you can know what things need to be improved.

Researcher: I think this will be my final question.....What are your views of an integrated system to monitor CVDs amongst PLHIV?

Respondent B: integration of patient care is very much important because that will help us to deliver quality services to clients like obese patients since we don't do anything about it currently.

Researcher: I know I said that was my question....(laugh)...do you have any questions or suggestions that will help us to prevent cardiovascular diseases amongst PLHIV?

Respondent B: Yes, since we don't have a platform to discuss CVDs I would suggest that we create an opportunity for all health facilities to come together and discuss best practices, see what they are doing, review data such as BMI and smoking history. That way we are guaranteed of feedback that is provided to the relevant people at the right time. Currently, we don't know how we are doing in terms of CVDs. The previous QI projects were learning sessions, but the project ended. And on top of that...different facilities are doing different things e.g. clients with high viral loads are booked Fridays at this clinic; Okuryangava clinic instead give them treatment every day and at other clinics nurses are doing house-to-house visits.....you see so many things are happening....an online platform may come in handy to encourage working together, sharing ideas and learning from others and to look at ways how we can harmonise all efforts so that we can speak from one mouth.

Researcher: Eish....that was a mouthful. Thank you for a very informative interview session with you. I think I understand your operations much better. Your time and responses are appreciated.

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Interview 3

Researcher: Good afternoon sir, I am Roswitha Mahalie, and I am conducting research with the aim of developing a surveillance and M&E framework for CVDs risk factor data and its subsequent use. I was given permission by the PS of MoHSS, the regional Director of Khomas region and the University of Namibia to continue with research (*permission letters shown to the interviewee*). Thank you for availing yourself by giving permission to be interviewed for the next 15-30 minutes. All information will be treated in the strictest confidence, responses are anonymous, and you are free to withdraw from the study at any given time without any implications against you as an individual.

Respondent C: You are welcome mem. You may go ahead.

Researcher: I would like to ask a few questions specifically about your involvement in data management practices. How do you collect data from patients and what do you do with this data and how do you report the data?

Respondent C: We collect data from OPD screening, Data is collected manually and captured in patient health passports and OPD tally sheets. We don't have electronic systems at this clinic. (*silence*)

Usually, we do our statistics at the end of every month and send to the reports to the regional HIS officer

Researcher: So, you send the reports to the regional office through the HIS officer? Is the HIS officer at the district level

Respondent C: Yes, we send through the district HIS officer, but her office is also at the regional office.

Researcher: Ok, what type of data do you send

Respondent C: We send Immunization coverage, OPD, Mother-baby follow-up for HIV exposed babies (DBS). We also send data for Family planning, ANC, PNC, PMTCT (monitor VL different), and growth monitoring.

Researcher: Do PLHIV come at the same place for screening where HIV negative people are currently being screened.

Respondent C:We offer integrated services but still we have a specific date when the doctor comes. ANC and PNC clients also have specific days to come to the clinic like normal patients.

Researcher: let me say ...when you screen a HIV positive woman and the blood pressure is high.....what do you normally do?

Respondent C: We first rule out the possible cause of high blood pressure. We do the urine dipsticks to check for proteins, then we ask questions about the lifestyle, we do the weight and provide health education especially in terms of diet.

Researcher: uhmmm

Respondent C: We monitor the BP for up to 3 consecutive days to get an idea of the trend.

Researcher: Do you get feedback from the patient once they are referred? Do you fill in a referral form

Respondent C: Yes, we have a referral form for whenever patients are referred. So, when they come back for other follow-ups, we to see what has taken place when they were referred. At times we also calls to find out what interventions were given to the patient.

Researcher: How do you deal with a patient does not need referral but probably just came in because of a spike in the BP for the short duration and the

Respondent C: We follow the same process whereby vital signs are taken, we give health education about healthy lifestyle. We talk about basic issues such as stress and how to release it. If the BP is high we must monitor it for 3 consecutive days to observe the trend. We have a limit as to when to send a patient for referral to a doctor. So, if the patient has a diastolic of >110 you are not allowed to send patient home. In the case where the BP remains high we refer the patient to the doctor. Sometimes it just requires from you to treat e.g. an infection and the BP will also drop. So, rule-out is important.

Researcher: How and where do you capture the BP readings of those patients who comes for 3 consecutive days.

Respondent C: the patient goes to the parameter table once he/she comes in. We check the BP and record it in the patient card. We do discuss the result with the patient. All BP readings are captured in the patient passport and the parameters book like we write it here..... (*interviewee displaying the parameter book*)....you see this one who are here are all for follow-ups. They are entered under follow-up visit on the tally sheet.

Researcher: You mention that you give patients health education about lifestyle and weight....do you also do BMI.

Respondent C: We don't to BMI. We will probably focus on it when we see that the person is unusually skinny.

Researcher: Ok, do you also talk about other risk factors for CVDs like smoking and alcohol with the patients.

Respondent C: Smoking and alcohol usage is not much emphasized unless there is a specific need like someone defaulting from chronic medicine because of alcohol.

Researcher: Do you record this data somewhere.

Respondent C: Not really. We don't really focus on it. Sometimes when the patient complains of cardiac problems we might take blood for cholesterol. But this is rarely done.

Researcher: So, you don't take regular cholesterol blood samples.

Respondent C: No

Researcher: how do you handle a client who comes to the clinic and is visibly malnourished?

Respondent C: we enroll them on the feeding scheme programme whereby plumtree nuts are given to them. However, very few are enrolled in the feeding scheme since these nuts are reserved for the patients on ARVs and children.

Researcher: if you see a patient with possible risk factors....do you use the data to inform further decision making?

Respondent C: yes, data is used for decision-making but only when we discuss for example during an emergency or whenever there are discrepancies with the data.

Researcher: Do you have a platform where you discuss critical data or outliers.

Respondent C: We only discuss when we have emergency cases especially after hours.

Researcher: Ok, so there is no platform to discuss the data here at the clinic.

Respondent C: Yes, we don't do data reviews.

Researcher: interesting.....Ok, I would like to find out whether you are satisfied with the current data collection efforts.

Respondent C: I lot needs to be done but what I think basically is to get more in-service training to emphasize the use of data for evidenced-based decision making. In our setting for example taking blood for cholesterol is not entered properly. We don't have anywhere to record it.

Researcher: So, everything is manually done. Do you prefer an electronic system?

Respondent C: Everything is manually done, so we are advocating for electronic systems since this is quite fast. Right now we are 70kms outside Windhoek and the only way that report can reach Windhoek is by sending it with the ambulance, if patients are taken to Windhoek, or even sometimes we are ask to take pictures of the summarized report and send it via WhatsApp to the HIS officers esp. immunization and ANC before the 3rd of every month. It will be good if we can get electronic systems, something that you can enter data and edit if you made mistakes. It is difficult if you send the hard copy and there mistakes on the form....it is hard to recall the report and correct the mistakes. With electronic you can edit quickly. I know there might be challenges, but it is quick to edit.

Researcher: hmmm....let me ask my last question (laugh)....how often do you get feedback from head office? Do you communicate with the head office?

Respondent C: Yes, we communicate only during DCC meetings.

Researcher: So, you get feedback?

Respondent C: Yes, from the HIS officer. They usually give feedback on critical cases every month but not on every indicator on the statistics....like malaria, and now we are having hepatitis E

Researcher: Data on CVDs is obviously not considered during feedback meetings.

Respondent C: Yes, it's is rarely considered during DCC meetings.

Researcher: how do you normally get your feedback?

Respondent C: It is in a report format that can be printed out. Print-out for cases are discussed. Even in our tally sheets there are a lot of things that are not captured that will enable us to make informed decisions. New cases of HPT are not discussed, and statistics are not clearly collected. For example, we can look at the new cases and say let's give health education around this and this area.

Researcher: I am done (laugh). Do you have any recommendations or questions you'd like to ask?

Respondent C: no, it's just that the discussion has opened up the challenges. Following this interview, I will be able to advise my colleagues on how to improve patient care. Especially those cases we have neglected like BMI we just have to do a proper investigation.

Researcher: Thank you very much for your time. I hope I've managed to stick to my time as promised (laughter).

Respondent C: you are welcome let me take you to the person working at the ART clinic.
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#### **Interview 4**

**Researcher:** Good afternoon Sr L, I am Roswitha Mahalie, and I am conducting research with the aim of developing a surveillance and M&E framework for CVDs risk factor data and its subsequent use. I was given permission by the PS of MoHSS, the regional Director of Khomas region and the University of Namibia to continue with research (*permission letters shown to the interviewee*). Thank you for availing yourself by giving permission to be interviewed for the next 15-30 minutes. All information will be treated in the strictest confidence, responses

are anonymous, and you are free to withdraw from the study at any given time without any implications against you as an individual. May I ask you a few questions?

**Respondent D:** Yes, you may go ahead.

**Researcher:** I would like to find out what type of data you are collecting, how do you collect the data and what are you doing with the data.

**Respondent D:** eissssh... How do I collect data?

**Researcher:** ok what I want to find out is when PLHIV presents with CVDs risk factors what are you doing with this data? Do you record it somewhere?

**Respondent D:**ohhh...I record it in the blue patient care booklet and I also record it in the patient health passport. If the condition is manageable in the clinic... I will manage it or intervene but if not I refer the patient to Katutura hospital. But from there we never really follow-up unless the patient comes for follow-up treatment at the clinic. No other treatment or CVDs are given

**Researcher:** if the patient has for example high blood pressure, tell me where do you enter that data?

**Respondent D:** We enter/record in the patient care booklet and also in the OPD screening book. And then we indicate on the OPD tally sheet which we submit to the HIS office at district level and this person submit to the regional...national level.

**Researcher:** National or regional level

**Respondent D:**hmmmm

**Researcher:** Do you get feedback from the national level

**Respondent D:** I think the national level give feedback to the regional and they give feedback to the district.

**Researcher:** Ok, how often do you get feedback at district level

**Respondent D:** It depends, maybe once per year but if there is a challenge or if there is a problem with the report they will give feedback where we need to improve.

**Researcher:** So, if there are no challenges...you only get feedback once or twice in a year.

**Respondent D:** Yeah.

**Researcher:** Ok I see. Do you enter data in ePMS at this level?

**Respondent D:** the one that we enter is just for ANC, Labour, PNC (eMTCT-eliminate MTC).

**Researcher:** in which system do you enter the data for ANC, labour and PNC

**Respondent D:** it is a system we call P-tracer....Yeah but PMTCT is now called eMTCT which means eliminate mother-to-child transmission of HIV.

**Researcher:** where do you send the P-tracker report.

**Respondent D:** If I enter it here at the clinic people at national level can view it immediately and if there are any problems or challenges they will give feedback.

**Researcher:** So, feedback is only given when there are problems or challenges.

**Respondent D:** No not with the P-tracker....with it they usually come and see whether the system is running, and they give feedback before they leave.

**Researcher:** Did they give you a written or printed report which contains the feedback.

**Respondent D:** The focus is on the P-tracker system for eMTCT. No written feedback was provided for the other reports submitted in the past.

**Researcher:** I think I am done. In summary it seems that hypertension is the most common risk factors data that is collected. The focus is not so much on BMI monitoring. And what I also realise is that blood for cholesterol is only taken when patient is complaining of heart related problems. But health education is given in terms of lifestyle diseases and diet.

**Respondent D:** most of the blood samples is taken on doctor's orders otherwise we will be taking unnecessary blood from patients.

**Researcher:** Ok...do you have a specific book where you capture the P-tracker data. I just want to look at the flow of data.

**Respondent D:** Like the flow of data is outlined in the P-tracker guidelines. I enter data for HIV+ and we only do follow-up that and not for HIV negative clients. For PMTCT I only enter the babies that are exposed. And for labour I enter all the patients and for

**Researcher:** oh, you have a specific guideline for P-tracker

**Respondent D:** Yes (*guidelines shown*)

**Researcher:** Are you aware of any guidelines that talks about the measuring risk factors for cardiovascular diseases among PLHIV?

**Respondent D:** I am not aware of any guidelines or policies that talks about only cardiovascular diseases among PLHIV. However, there are obviously other guidelines such as National Guidelines for Antiretroviral Therapy that I am aware of.

**Researcher:** Thank you very much for your time and for contributing to my research. It is much appreciated.

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## **Interview 5**

**Researcher:** Good afternoon Sr, I am Roswitha Mahalie, conducting research to find out more about data capturing and use of CVDs risk factors amongst PLHIV. I was given permission by the PS of MoHSS, the regional Director of Khomas region and the University of Namibia to continue with research (*permission letters shown to the interviewee*). Thank you for availing yourself by giving permission to be interviewed for the next 15-30 minutes. All information will be treated in the strictest confidence, responses are anonymous, and you are free to withdraw from the study at any given time without any implications against you as an individual. May I ask you a few questions?

**Respondent E:** Yes, I am actually not sure whether I will be able to answer all your questions but let's try.

**Researcher:** How often do you deal with cardiovascular diseases in the clinic and what do you with the data you capture after you've provided nursing care.

**Respondent E:** We generally do most of the parameters such as Blood pressure, weight, height, temperature, pulse and respiration. Patient care is provided according the complaints raised. And if there are any abnormalities in the vital signs we make sure that they are treated accordingly.

**Researcher:** Where do you collect these parameters

**Respondent E:** We use the patient health passport and OPD screening book to record everything that is done with the patient. From there it is captured on the tally sheet. All tally sheets are collected from the different consulting rooms and a summary report is send to the district HIS.

**Researcher:** Ok, now let me say, you've seen someone with high blood pressure, how do you normally deal with such a person.

**Respondent E:** The person is advised to come back to the clinic for at least 3 times. If there is no improvement, we refer the patient to the doctor. But at the onset, if the blood pressure is high we need to rule out the cause of the high blood pressure prior to putting the person on lifelong hypertensive treatment.

**Researcher:** Do you follow the people who are on hypertensive treatment for a while to see how they are faring.

**Respondent E:** No, we don't follow-up hypertensive patients(*laugh*). We wait for them to come and collect their treatment at the clinic once the pills are finished.

**Researcher:** Oh...don't you have a specific standing order or guideline for the follow-up of patients with hypertension.

**Respondent E:** We don't have hypertension guidelines...it is maybe somewhere but I know we before patients are put on the antihypertensive treatment they come to see for 3 consecutive days to the clinic for BP check.

**Researcher:** Tell me about the feedback you receive from your district office.

**Respondent E:** We attend the DCC meeting to discuss critical cases such as immunization and serious conditions like hepatitis and cholera.

**Researcher:** How about cardiovascular diseases

**Respondent E:** ehehehe....no we usually don't discuss cardiovascular diseases.

**Researcher:** How often do you get feedback on your monthly reports?

**Respondent E:** How often we receive feedback....hmmm...mostly when there are challenges and at the regular DCC meeting.

**Researcher:** Ok...hmmm...interesting, do you have any other thing that you would like to add, recommend or suggest?

**Respondent E:** Not at the moment. Let me take you to the doctor working at the ART clinic.

**Researcher:** Thank you very much.  
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## **Interview 6**

**Researcher:** Good afternoon Dx, I am Roswitha Mahalie as introduced by Sr. I would like to ask a few questions regarding CVDs data and its risk factors amongst PLHIV. Ethical considerations will be adhered to, and I have received permission from the PS of MoHSS, the regional Director of Khomas region, and the University of Namibia to continue with research (*permission letters shown to the interviewee*).

**Respondent F:** Good afternoon, you may go ahead with the question

**Researcher:** how often do you deal with the combination of patients on ART but who are also taking pills for hypertension

**Respondent F:** Quite often but I can't recall the statistics now.

**Researcher:** Are you the one taking parameters for the patients who comes to your consulting room?

**Respondent F:** No, the health assistants are taking all the parameters such as blood pressure, weight, height, and MUAC after the patient has registered at the reception.

**Researcher:** Tell me, where do you record the data you are collecting for CVDs

**Respondent F:** I record the all hypertensive cases on this sheet (*tally sheet shown to me*)

**Researcher:** what do you do with those tally sheets

**Respondent F:** I give the tally sheets to the Sr- in -charge of the clinic, and I think she summarizes it and sends it to the next level.

**Researcher:** Do you know where exactly it is sent.

**Respondent F:** I am not sure to whom she sends the summary reports but I think the data entry clerk can maybe assist with that information.

**Researcher:** Have you ever receive any feedback regarding the data you are capturing and forwarding to the Sr-in-charge.

**Respondent F:** Nofeedback was given to me on the tally sheets that I have submitted to date.

**Researcher:** So, you don't attend data review sessions.

**Respondent F:** No, I have never attended a data review session, let us rather ask the data entry clerk. She will know more about ay data review sessions and feedback.

**Researcher:** Thank you very much for your time and valuable input doctor.

**Respondent F:** You are welcome

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### Interview 7

**Researcher:** Good afternoon ma'am, I am Roswitha Mahalie, conducting research to find out more about data capturing and use of CVDs risk factors amongst PLHIV. I was permitted by the PS of MoHSS, the regional Director of Khomas region, and the University of Namibia to continue with research (*permission letters shown to the interviewee*). Thank you for availing yourself by giving permission to be interviewed for the next 15-30 minutes. All information will be treated in the strictest confidence, responses are anonymous, and you are free to withdraw from the study at any given time without any implications against you as an individual. May I ask you a few questions?

**Respondent G:** I am actually busy with a report.

**Researcher:** I will only take a few minutes of your time

**Respondent G:** Aiyee.....(*respondent seems unwilling to be interviewed*)

**Researcher:** Do you have a backlog?

**Respondent G:** Yes, I am far behind with my data entry

**Researcher:** Do you perhaps need assistance with data entry?

**Respondent G:** Nooooo, I am the only person who is allowed to enter data into this database

**Researcher:** Ok I see.....when was the last time you've attended a data review session?

**Respondent G:** In October this year.....

**Researcher:** Ok, who is responsible for organizing data review sessions?

**Respondent G:** The district health office.....you can get the information from them

**Researcher:** From who can I get the information?

**Respondent G:** From the PHC supervisor

**Researcher:** One more quick question: where do you capture blood pressure readings from patients who are receiving ART.

**Respondent G:** there is no provision for BP readings in the Quantum database, but BP is captured in the patient care booklet in a separate column (*shows where BP readings are recorded in the PCB*).

**Researcher:** Thank you for your valuable time

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### Interview 8

**Researcher:** Good afternoon Mr, I am Roswitha Mahalie, currently collecting for my doctoral studies which I am doing through UNAM. The focus of the study is the development of a surveillance and M&E framework for CVDs risk factor data. The interview is supposed to take between 15-30 minutes depending on the answers you are providing. Thank you for availing yourself by giving permission to be interviewed. As indicated in the information leaflet, all information will be treated in the strictest confidence, responses are anonymous, and you are free to withdraw from the study at any given time without any implications against you as an individual.

**Respondent H:** you are welcome.

**Researcher:** Do you currently collect routine data to improve screening for CVDs risk factors and do you use the data for decision making and/or improving health services provided to PLHIV at our facility.

**Respondent H:** Yes, to the first question. We record all client parameters in the patient care booklet. We take parameters from every client that visits our facility e.g. blood pressure is taken by health assistants and the readings are entered into the patient care booklet. We have noticed that hypertension and renal conditions are one of the risk factors of CVDs. For example, most of our clients who are on ART present with renal conditions which is a major contributing factor to CVDs. I believe if we monitor these clients on a daily basis we will be able to rule out

CVDs. We also have weighing scales where we do the Weight + Height to determine the clients' BMI. The higher the BMI the more obese the client is and that may make them more susceptible to CVDs. Blood is also collected by using the NIP tubes for creatinine to monitor the kidneys.

**Researcher:** Ok....creatinine

**Respondent H:** Yeah, creatinine is used to monitor the kidneys. We are aware that renal conditions and CVDs go hand-in-hand. We also do HGT for clients with blood glucose tests subsequently especially if the HGT results are very high.

**Researcher:** So, you do blood glucose tests as a routine

**Respondent H:** Yes, fasting blood glucose is done to ruleout any form of diabetes. We are also aware that the prolonged use of ART affects the kidneys which in turn may also affect the cardiovascular system.

**Researcher:** Do you perhaps have an idea of how many PLHIV are hypertensive at this facility.

**Respondent H:** I think that information you can only get from the ePMS system. For now, I can say that they are not a lot of hypertensive clients living with HIV but the number is increasing on a yearly basis.

**Researcher:** So, in ePMS you capture all the client-related data?

**Respondent H:** Yeah, in ePMS we capture all the information that we record in the patient care booklet.

**Researcher:** everytime.....

**Respondent H:** Yes, every time the client comes for a visit we capture the information. Thereafter the data clerk enters this information from the patient care booklet into ePMS.

**Researcher:** So, the data clerk was also trained on the new quantum system

**Respondent H:** Yeah, they were trained but the quantum I think there are only a few indicators that were picked out and I am not sure if hypertension is one of them as well. That information we can get from the data entry clerk.

**Researcher:** So, we will get that information from the data entry clerk.

**Respondent H:** Yes, everything we record in the patient care booklet is captured in ePMS

**Researcher:** in terms of the other parameters, what do you do with the results.

**Respondent H:** We have QI projects that we run on a quarterly basis. We have NAMLIFE and NAMPROPA.

**Researcher:** So, you are doing both projects

**Respondent H:** No, we are not doing both at the moment. The projects are more-or-less the same. The only difference is that BP is excluded in NAMLIFE since we have reached our target which is 100% so that's why that data element is excluded. Basically...as I said we have NAMLIFE where we monitor our clients. We monitor how many clients are hypertensive and from those who are hypertensive how many of them are on treatment. I think one of the leading factors of hypertension and other cardiovascular diseases is that clients are not given enough information that this medicine is lifelong. Clients only take the medicine for a few days and once they feel better they drop out. When you ask them but why are you not drinking the medicine, they will tell you that they are feeling ok. That is where health education should come in because you might think that you are well now but what if your BP shoots up again.

**Researcher:** So, where do you record the NAMLIFE data

**Respondent H:** we have a NAMLIFE book where we get the data from our BP book, there is VL monitoring as well, so when we draw blood we get the data from NIP from the terminal system. We have EPI as well.

**Researcher:** EPI what is EPI

**Respondent H:** Actually, IPT which is Isoniazid preventive therapy but now it is called TBT (Tuberculosis Preventative Therapy) where we give the client 6 months dose of isoniazid while they are on ART to prevent them from getting TB while they are on ART.

**Researcher:** You don't give co-trimoxazole any more.

**Respondent H:** Co-trimoxazole is only in the NAMPROPA project but anyway co-trimoxazole is given to those clients who have a CD4 count below 300. It is normally stopped once the CD4 count goes above 350 again.....Not everyone gets co-trimoxazole.

**Researcher:** So that is basically the data that you collect. To whom do you report the data that is collected in the Namlilfe book.

**Respondent H:** we report the data to Dr.Kapuku the clinical mentor who oversees all the facilities in the country. What happens is that we capture the data in the NAMLIFE book and enter it into the template or spreadsheet on our desktop and send it to Dr.Kapuku via email who in turn sends it to the MoHSS.

**Researcher:** Where do you report the BP, weight, height, BMI, and the rest of the other parameters.

**Respondent H:** BP and height are usually recorded in the patient care booklet on a daily basis. The data entry clerks pick up the patient care booklets and usually enters the data into the ePMS.

**Researcher:** Ok, so how often do you get feedback from the MoHSS on the data extracted from ePMS or NAMLIFE spreadsheet.

**Respondent H:** Usually with NAMLIFE we meet on a quarterly basis where they give feedback on how we are performing. That is all I am aware of. I am not sure of feedback from DSP on ePMS data.

**Researcher:** The quarterly meeting with the clinical mentor does it only focus on the NAMLIFE project?

**Respondent H:** Yes, the quarterly meeting focus on the NAMLIFE project whereby the clinical mentor comes every week for support visits. She gives feedback whenever there is a need. We also have a nurse mentor who is responsible for monitoring VL.

**Researcher**...hmmmm...how do you use the data to make decisions in your clinic. Do you develop action plans during these data review sessions?

**Respondent H:** uhhha...that is one thing that we haven't done before...an action plan. I think we need to put action planning into our data review sessions.

**Respondent H:** we have what we call monthly meetings to discuss data around IPT and PReP.Surprisingly we have a higher number of people on IPT which we are doing extremely well. But we don't have data review meetings where we discuss cardiovascular diseases or even diabetes and its risk factors.

**Researcher:** Who prepares the reports for you?

**Respondent H:** I usually prepare the reports....laughs

**Researcher:** How do you present your data? Do you do graphs to display your achievement

**Respondent H:** Yes, we use graphs to present the specific indicators.

**Researcher:** How are graphs displayed.

**Respondent H:** It is usually computer generated but it has been a while since we have done it. This is mainly due to challenges with computers.

**Researcher:** Do you have any other thing to add.

**Respondent H:** The report of the ART clinic is sent to my supervisor who is the overall in charge of the Katutura health centre, who sends it to the PHC supervisor.

**Researcher:** So, the only data you are using or interrogating is IPT and PReP.

**Respondent H:** The clinic is usually very busy so the focus is on IPT, PReP, and TB for now.

**Researcher:** Do you have any other thing you would like to add or recommend.

**Respondent H:** Yeah.....there was a project where each staff member was evaluated on a set of data elements e.g. 10. I wish we could get computers to assist with easy data entry whereby each staff can enter different parameters in the various consulting rooms. It makes it easier for us to just extract the data and accumulates it from the different spreadsheets at once

instead of manually preparing data and collate it afterward. This current practice is prone to mistakes. My wish is that all healthcare workers are trained on the importance of data collection because if you know why you should collect data you will make sure that you follow the correct ways. I think that's all from my side.

**Researcher:** Thank you very much for your time and willingness to be interviewed.

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### **Interview 9**

**Respondent H:** Hi E.....we have a visitor who would like to ask you a few questions. She will introduce herself

**Respondent I:** a visitor.....(laugh).....ok

**Respondent H:** (respondent leaves the room)

**Researcher:** Good morning afternoon sir, I am Roswitha Mahalie conducting research on ways how we can use valuable data which is normally captured at your clinic to inform improved services for both the client and the health fraternity. I have one question for you and subsequent questions will follow based on the information provided for the first question. The interview is supposed to take between 15-30 minutes depending on the amount of detail that is deliberated upon. However, you are free to stop the interview at any given time.

**Respondent I:** Ok.....no problem....let me quickly save what I am busy with...

**Researcher:** I see you are using the new Quantum data base. How do you find it?

**Respondent I:** like you said, the quantum database is new and we are experiencing a few challenges e.g. we are unable to run reports yet unlike with the previous ePMS system. Yeah...we can't extract data to give specific information related to the client. For example, if we follow-up blood results we will have to look for it manually. I have actually realised that the work is more with this new system

**Researcher:** Ok, what could be the reasons for not generating reports?

**Respondent I:** The system is still being tested and whatever changes will probably be fixed as we are giving feedback to our focal person at DSP. The system only makes provision for demographic data and this is for those patients who were newly initiated on ART.Extraction of reports was done with the old ePMS and we don't do graphs like in the past.

**Researcher:** ok.....hmmm.....it is very interesting.....now, where do you capture the parameters that are taken from patients on a daily basis.

**Respondent I:** Follow-up parameters are not entered into the database. It is recorded in the patient care booklet and passport.

**Researcher:** I see.....

**Respondent I:** BMI is only entered if height is indicated in this system. Quantum give you what you have.....it is limited.

**Researcher:** limited in what sense.....

**Respondent I:** With the previous projects such as HIVQual and NAMPROPA we were able to enter such information in their data bases. But unfortunately, with this new system which is piloted in our region things are complicated.

**Researcher:** Let's talk a bit about feedback .....how often do you get feedback from your supervisors

**Respondent I:** Feedback is usually given by DSP whenever we report a specific problem or sometimes during workshops. But to date no written feedback on reports were given to us.

**Researcher:** Have you ever attended a data review session conducted by your supervisors?

**Respondent I:** Data review meetings are happening quarterly. Every clinic presents and match results against what was reported.

**Researcher:** Don't you consider that as feedback that is given. Were you not provided with the data review report?

**Respondent I:** It might be feedback.....(*rolling eyes*)..... but shouldn't we get feedback in writing or discuss our data here at the clinic?

**Researcher:** Ok.....I see

Quiet.....

**Researcher:** Ok thank you very much for your time. I appreciate your input.

**Respondent I:** you are welcome

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## **Interview 10**

**Researcher:** Good morning Maria, as we have already met, and we know each other since our nursing student years I am here for the interview according to our appointment. I have one question for you and subsequent questions will follow based on the information provided for the first question. The interview is supposed to take between 15-30 minutes depending on the amount of detail that is deliberated upon. Capturing of CVDs risk factor data at the various clinics; What are you doing with the data once its captured; When you get the reports from the different health facilities how do you collate the data

**Respondent J:** You are actually very lucky that one of the clinics forwarded their reports a few minutes ago. In my response I will be referring to this specific report. Reports are reported in the first or second week of the month.

The client first start at the reception. From there the client is directed correctly once it was ascertain the reasons that brought you to the clinic. From there you go to the parameter room if you are an adult, but the minors normally goes to the peadiatric area in bigger clinics. But in smaller clinics everybody awaits their turn in the waiting area for the next available consultation room.

**Researcher:** uhmmm

**Respondent J:** Parameters that are taken are normally blood pressure, weight, temperature and if the person is diabetic or present with diabetic related symptoms only than HGT is done. Due to staff shortage it is difficult to do HGT for each and every patient. The rest of the parameters are done based on the history you are presenting with.

**Researcher:** Uhmmmm

**Respondent J:** Once the client is screened in a consulting room and the nurse cannot manage the condition the client is referred to the Dr but mostly CVDs are not directly diagnosed by the nurses. The client must have a certain syndrome related to CVDs for the person to be diagnosed with Hypertension or any other CVDs. If somebody is found with an elevated BP you are monitored for 3 consecutive days to determine whether the person has hypertension or any other CVDs related conditions. The Dr will do the ECG and see what is relevant to this client.

**Researcher:** so that is how you collect data at the different clinics. Once the clients are referred to the Dr after the initial screening and recording of parameters, what happens after that?

**Respondent J:** Data is collected.....

**Researcher:** Where do you capture the data

**Respondent J:** We don't capture the data.....hmmm....we record everything manually in the sense that each room has got a screening book

**Researcher:** ehe.....

**Respondent J:** It is called an outpatient register where the following information of the patient is entered: age, erf number and cellphone number. There is a column that is asking for the signs and symptoms, diagnosis, referral or even if something is queried or something has to be done to the patient.

**Researcher:** For interventions

**Respondent J:** Yes, or referral to the doctor is also indicated as such.

**Researcher:** oho

**Respondent J:** The classification for specific diseases or cases can only be done once the client was seen by the doctor. However, if the classification is done in the consulting room of the nurse, the prescription is done by the nurse and the client goes to the pharmacy to collect the medicine. Normally CVDs are not easily diagnosed at the first encounter with the client. Many investigations are done before the final diagnosis is confirmed and ruled-out.

Once you collect data in any room, it is collated and put together at the end of the month.

**Researcher:** collated.....who does that

**Respondent J:** The nurse

**Researcher:** The nurse -in -charge

**Respondent J:** Any nurse who is screening plus the doctor puts together the data at the end of the month. Like I said each room has the OPD register and a tally sheet where you enter how many clients were seen per day and for the whole month. What I have here is only the summary sheet. The HIS officer is now on leave and in her absence whoever enters the data must make sure that it is valid.

**Researcher:** where does the person enter the data

**Respondent J:** Here at the district level. So, everything comes in a hard copy like this (*interviewee displaying the summary sheet.....*) and is entered by the HIS and surveillance officer .....one at the district and another one at the region which is called MIS. At the clinic everybody collects data, then sister in charge summarises the different reports and send the summary sheet to the district office before the 5th of every month. By the 7th the reports must have reached the national level. Now the system has been changed since data is put on the website.

**Researcher:** DHIS2

**Respondent J:** Yes DHIS2. Once you enter the data here it is automatically viewed at the national level. It used to be a process whereby the data was sent from facility to district to region and only thereafter it was exported to the national level. That system is phased out and now we have DHIS2 whereby data is readily available to be extracted at national level for each service area e.g. non-communicable diseases of reproductive health.

**Respondent J:** The second question was about what again

**Researcher:** It was about the use of data

**Respondent J:** We use data in many ways. Look at the EPI data. We know that data is very important Data is important. Data for action helps with the allocation of staff and other resources, planning for accelerated activities or even during outbreaks of diseases. If we look at the statistics we are the best in the country in terms of staff allocation. We only have 12 facilities but because of the statistics we have most nurses than all the other regions. Each clinic in Khomas district has 5 enrolled nurses and maximum 4 registered nurses because of the volumes of clients that are seen at these clinics. While some regions have e.g. 1 registered nurse and 2 enrolled nurses. For example, a clinic like Okuryangava sees up to 10 000 clients a month. Now the data we collect

**Researcher:** How often do you give feedback to the facilities

**Respondent J:** We have monthly meetings which is called district coordinating committee meeting. We discuss the reported data at these meetings and give feedback to the nurse-in-charge of the specific clinics. We have a schedule for the whole year. The senior medical officer is the chair, I deputise as the PHC supervisor, chief Dentist, EHS chief, chief for administration, social worker and all the clinic managers and the programme coordinators. So, we meet every 3rd week of the month. The same team has a WhatsApp group, so any health-related problems are discussed on this platform.

**Researcher:** hmmm...is the feedback that was provided to the nurses documented or compiled in a specific report.

**Respondent J:** No, we don't send reports to the clinics but obviously if there is a disease outbreak that requires immediate attention we find ways to communicate to the team like the WhatsApp group. Look at this.....this is the last meeting for the year we recently held on Monday.

**Researcher:** Wow

**Respondent J:** These meetings are fruitful. By every 7th of the month the data is reported to WHO. This is serious because our countries health is measured against reported data of under-fives and women of child-bearing age (15-49 years).

**Researcher:** the focus is not so much on CVDs.

**Respondent J:** There is an insert for NCDs in the strategic plan. It is not that we don't focus on CVDs...look at this CVDs is Nr 4 here...hypertension and other CVDs is recorded on the OPD summary sheet. Any person diagnosed with CVDs are treated as an emergency and sent immediately the Cardiac unit at WCH once the ECG was done by the doctor.

**Researcher:** what are strategic documents do you have that refers to interventions or measurement of risk factors of CVDs.

**Respondent J:** The general hypertension guidelines is outdated but it was developed in 2005.

**Researcher:** So, you've mentioned how data is collected, collated and used but do you get written feedback from the region or national level regarding CVDs.

**Respondent J:** No, I don't know of written feedback, but I think if there are issues they communicate via internet. Focus is currently on EPI and not so much on NCDs.

**Researcher:** I think we have come to the end of our interview. Thank you very much for your time and valuable information you've shared with me. I hope that this information will help us to develop a surveillance and M&E framework for CVDs risk factor data and its integration amongst PLHIV.

**Respondent J:** It was a pleasure sharing the information with you.

**Date: 19 December 2018. Time: 08h00**

**Duration: 21 minutes**

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## **Interview 11**

**Researcher:** Good afternoon sister, I am Roswitha Mahalie, as I have introduced myself previously. The PS of MoHSS, the regional Director of Khomas region and the University of Namibia has given me permission to conduct the study at the MoHSS health facilities in Khomas region (*permission letters shown to the interviewee*).

**Respondent K:** Good afternoon, you are well come. Like I said the sister in charge is on leave and I am acting on her behalf.

**Researcher:** Thank you for availing yourself by giving permission to be interviewed for the next 15-30 minutes. All information will be treated in the strictest confidence, responses are anonymous, and you are free to withdraw from the study at any given time without any implications against you as an individual. May I continue with the interview by asking you a few questions?

**Respondent K:** You may go ahead.

**Researcher:** Tell me sister, do you currently collect data to improve screening for CVD risk factors and improve practices for CVD-related preventive care services amongst clients enrolled for ART?

**Respondent K:** Yes, all clients who are initiated on ARTs and those who are coming for follow-up treatment are first going to the health assistants where parameters are taken such as BP, pulse, respiration, saturation, weight and height. All clients who are initiated on ART are specifically screened for TB, past medical history, questions are asked about their smoking and

drinking usage and habits, general systems review, and a full physical examination is given to all the clients.

**Researcher:** hmmm, interesting. Once this data is collected, where is it entered and what do you do with the data afterwards?

**Respondent K:** the parameters are captured in an ordinary parameters book which is later used to do daily tallying by each nurse. The sister-in-charge compiles the monthly statistics and send it to the PHC supervisor at district level. Some statistics are sent on a weekly basis to the PHC supervisor

**Researcher:** So, the PHC supervisor tells you what to do with the data...

**Respondent K:** No not completely, in fact the focus is not so much on risk factors for cardiovascular diseases. In most instances when a clients' blood pressure is high we ask the him/her to come for 3 consecutive days for BP check and proper monitoring. If the BP is still high, we refer the patient to the doctor. The doctor will initiate the first BP treatment since we as nurses are not mandated to do that, but follow-up treatment is dispensed at the clinics. Other than that, nothing is done if the BP normalises. Remember also that baumanometers are also one of the challenges at the clinic. If it is not working or its being used in one of the screening rooms than obviously BP will not be taken.

**Researcher:** Now what do you do if the client has a drinking problem and yet this client needs to be initiated on the ART programme.

**Respondent K:** those are the clients that are normally defaulting but to be honest there are TCE volunteers who follow-up on those clients. They know the whereabouts of all the defaulters.

**Researcher:** So, you don't talk about CVDs with a client who is for example smoking and drinking heavily.

**Respondent K:** although general health education is sometimes given on hypertension and diabetes mellites, there is no specific indicator on these diseases that requires constant monitoring in ePMS. Maybe the patient care booklet should be adjusted sothat we can monitor BP and diabetes on a regular basis.

**Researcher:** do you meet regularly to discuss about data issues with specific focus on CVDs?

**Respondent K:** we have monthly department meetings which is scheduled for every last Thursday of the month to discuss data in general. So mostly data around EPI, IPT and TB is discussed.

**Researcher:** Do you analyse the data before these meetings?"

**Respondent K:** analysis...maybe we do it, but no graphs are presented. We actually just talk about it, so I am not sure whether that is good enough.

**Researcher:** So, you don't discuss with the client when his/her BP is high or when they have been smoking?

**Respondent K:**aiye...we will probably tell the client your BP is high or sometimes to look at the diet...but honestly speaking there is no standardised way of doing it. As a health worker I will always talk to the clients about healthy living, but these are definitely not recorded anywhere.

**Researcher:** You mentioned earlier that baumanometers are a challenge.

**Respondent K:** Yes.....

**Researcher:** What other challenges are you experiencing currently in terms of capturing data that would help us to improve interventions for PLHIV.

**Respondent K:** Vital signs are always done but you know we don't do it to monitor cardiovascular diseases. That's why I think these things should be standardised.

**Researcher:** What should be standardised?

**Respondent K:** Guidance should be given on what we should do with all the parameters that are taken from clients for cardiovascular diseases. These things should be standardised and

discussed with the client in detail. For example, basic equipment like measuring tapes are a challenge. Sometimes we can't measure the BMI of a patient due to the absence of the measuring tape.

**Researcher:** I see...hmmm. Are you aware of any policies or guiding documents that talks about risk factors for cardiovascular diseases.

**Respondent K:** I am not aware of policies or guiding documents specifically for cardiovascular diseases among PLHIV. All patients get the same treatment when they are sick with other conditions.

**Respondent K:** Yes, and capacity is also another challenge. We have too many patients with few nurses who are doing the work. More nurses should be employed.

**Researcher:** Ok it is true; more nurses are needed if we want to make sure that integrated services are properly delivered. May I know what exactly you are doing with data for CVDs risk factors?

**Respondent K:** I think we need champions who can advocate for the use of this data. Remember sometimes we are understaffed, and we only focus on screening and treating patients. So, any other responsibilities are not prioritised.

**Researcher:** Feedback...do you get feedback on your monthly statistics that is sent to the PHC supervisor.

**Respondent K:** Sometimes there are data review meetings but as I mentioned earlier CVDs are definitely not a priority at these meetings.

**Researcher:** Ok I see (looking at the time)...I think we have come to the end of the interview. Do you have any questions?

**Respondent K:** No, I think I don't have any further questions.

**Researcher:** Thank you for taking time to respond to my questions. Enjoy the rest of your afternoon.

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## **Interview 12**

**Researcher:** Good afternoon Sr, As I have mentioned over the phone I would like to ask a few questions regarding national policies or guidelines on non-communicable diseases and its integration into routine primary health care service delivery and specifically ART programs. You may also wish to highlight your involvement in any data management activities.

**Respondent L:** I am not involved in any data management. As focal person for the NCD program, I ensure that NCDs interventions receive the necessary attention.

**Researcher:** Are you involved in any programs currently implemented at DSP on the integration of NCDs into ART programs?

**Respondent L:** I guess we still need to come to a point where we will merge our programs and work together to ensure integration of NCDs into ART or any other standalone program.

**Researcher:** So, what are you currently doing in terms of advocating for interventions for cardiovascular diseases at primary health care level.

**Respondent L:** We have adapted the World Health Organization Package of Essential Non-communicable Disease Interventions (WHO PEN) for Primary Health Care in Low-Resource Settings to draft the national guidelines which will hopefully be integrated into all PHC programs. The guidelines which are in draft format are yet to be finalized. All risk factors for non-communicable diseases are selected and certain modules were extracted and tailor-made to the Namibian situation. Modules basically include Health Education and Counseling on Healthy Behaviours; Prevention of Heart Attacks, Strokes and Kidney Disease through Integrated Management of Diabetes and Hypertension; Chronic Respiratory Diseases and Palliative Care. This project is currently piloted in Hardap and Kavango East and West regions and it aims at looking at the risk of cohorts over a 10-year period.

**Researcher:** hmmm, that sounds interesting.

**Respondent L:** Yes, at the end of the day we want to see the patient as holistic being. For example, even if the person comes for a minor ailment, we want to see his/her blood pressure and other risk factors are monitored. Although the WHO PEN do risk assessments of clients from 40 years and above, the National focus has been adjusted to cater for those from the age of 18 years and above. This is basically because of the high prevalence of hypertension, stroke and myocardial infarction in the country.

**Researcher:** how do you know the prevalence of hypertension, stroke and myocardial infarction is high in the country?

**Respondent L:** To date, risk factors for non-communicable diseases are not routinely captured at the clinics for all clients/patients. However, we are guided by the 2014 Namibia Demographic and Health Survey to determine the prevalence of NCDs. We have included indicators to specifically measure risk factors for non-communicable diseases.

**Researcher:** Are you aware of any M&E plan and other national guiding documents and policies that integrates risk factors for CVDs captured from PLHIV?

**Respondent L:** We have quite a number of documents such as the national Multisectoral strategic plan for prevention and control of NCDs; MoHSS health policy; MoHSS strategic plan; the hypertension guidelines but these are outdated and needs to be revised; the Namibia Tobacco Control, Act 2010. There are also NCD diet related guidelines that were recently developed. Remember we are also using surveys like the NDHS of 2014.

**Researcher:** That was a mouthful...Do you think healthcare workers are aware of the existence of these national documents.

**Respondent L:** I would say some are not aware of the existence of these documents because whenever we ask them about the national documents they will always deny the existence of such documents. I remember removing on two separate occasions the older version of the hypertension guidelines from cupboards at health facilities. We need to cultivate a reading culture perhaps

**Researcher:** I think we are about to conclude the interview but tell me what the challenges or gaps in terms of integrating cardiovascular diseases into ART programs are.

**Respondent L:** Health programs are not integrated although we are striving towards such integration. It is high time that we standardised all health services from the lowest to the highest level. Obviously there are gaps and challenges such as human resource shortage has become the biggest concern. Other challenges are much needed finances to buy equipment such as baumanometers, ECG and ultrasound machines, weighing scales and measuring tapes for primary health care facilities. Look for example we needed to do a community awareness session where HGT was supposed to be done but we were simply told that HGT strips are not-in-stock at central stores.

**Researcher:** This is really useful information. Any last thoughts or ideas from your side?

**Respondent L:** implementation of existing national documents in future might be one of the benefits that will come from such integration.

**Researcher:** Thank you very much for your time and valuable information.

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## ANNEXURE 8: PRINTSCREEN OF QUANTITATIVE DATA EXTRACTION SPREADSHEET

The screenshot displays an Excel spreadsheet titled 'Final\_Risk\_Factors23092019 - Excel'. The data table has the following columns: A (Unique ART Code), C (Urban/Rur), D (Gender), E (Marital Status), F (Age), G (Weight), H (Height), I (BP\_Systolic), J (BP\_Diastolic), K (BMI), L (Recordkee), M (Recordkeepi), N (Data\_Quality\_Risk), O (%Missing), P (Data\_Qual), Q (High\_BP\_Risk), R (Systolic), S (High\_BP\_F), T (Age\_categor), and U (Anthro). The rows contain individual patient data points, such as '421031401541' in row 2, which is an Urban Male with Age 47, Weight 51, Height 158, BP\_Systolic 100, BP\_Diastolic 90, BMI 16.4, and Risk status 'Excellent'.

| Checklist for data extraction |                                       |
|-------------------------------|---------------------------------------|
| Initial Variables             | Additional variables analysed in SPSS |
| UniqueARTCode                 | RK_Risk                               |
| healthfacility                | Recordkeeping                         |
| UR                            | DQ_Risk                               |
| Sex                           | Missing or inconsistent data          |
| Marital status                | High_BP_Risk_SB                       |
| Age                           | High_BP_Risk_DB                       |
| Weight                        | Agecat                                |
| Height                        | Anthrom_indic                         |
| BP_Systolic                   | At_Risk_Smoke                         |
| BP_Diastolic                  | At_Risk_Alcoh                         |
| Weight                        | ART_Start_Year                        |
| Height                        | Total Average of FP_Days              |
| BMI                           | Total Average of visit_per year       |
|                               | Client_Reten_ePMS                     |
|                               | Risk_CVDs                             |

## ANNEXURE 9: LANGUAGE EDITING



**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

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01 October 2020

TO WHOM IT MAY CONCERN

LANGUAGE EDITING – MS ROSWITHA MAHALIE (9218602)

This is to confirm that a Doctor of Public Health dissertation titled "A novel surveillance framework for tracking and predicting health outcomes of cardiovascular diseases risk factors among people living with HIV initiated on art in Khomas Region, Namibia" by Ms Roswitha Mahalie, student No. 9218602, was submitted to me for language editing.

The dissertation was professionally edited, and suggestions were made in the document, which if followed by Ms Roswitha Mahalie, will result in a dissertation with a high standard of English. Given the nature of the process, I restricted my editing to language issues, which I feel have now been satisfactorily resolved, but I remain available for consultation as long as necessary.

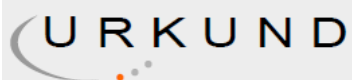
Please feel free to contact me should you need more information. My contact details are:  
Tel: +264 61-2072285; Cell: +264 813926498. Email: [jpasi@nust.na](mailto:jpasi@nust.na)

Yours faithfully

A handwritten signature in black ink, appearing to read "J. Pasi".

Dr Juliet S. Pasi  
Senior Lecturer – Communication Department  
B. A. English & Linguistics  
B. A. Special Honours in English  
Graduate Certificate in Education  
M.A. in English  
DLitt et Phil

## ANNEXURE 10: URKUND ANALYSIS RESULT



### Urkund Analysis Result

Analysed Document: Roswitha Mahalie\_Final Version\_28 November 2019.docx  
(D59825697)  
Submitted: 11/28/2019 1:17:00 PM  
Submitted By: hmitonga@unam.na  
Significance: 1 %

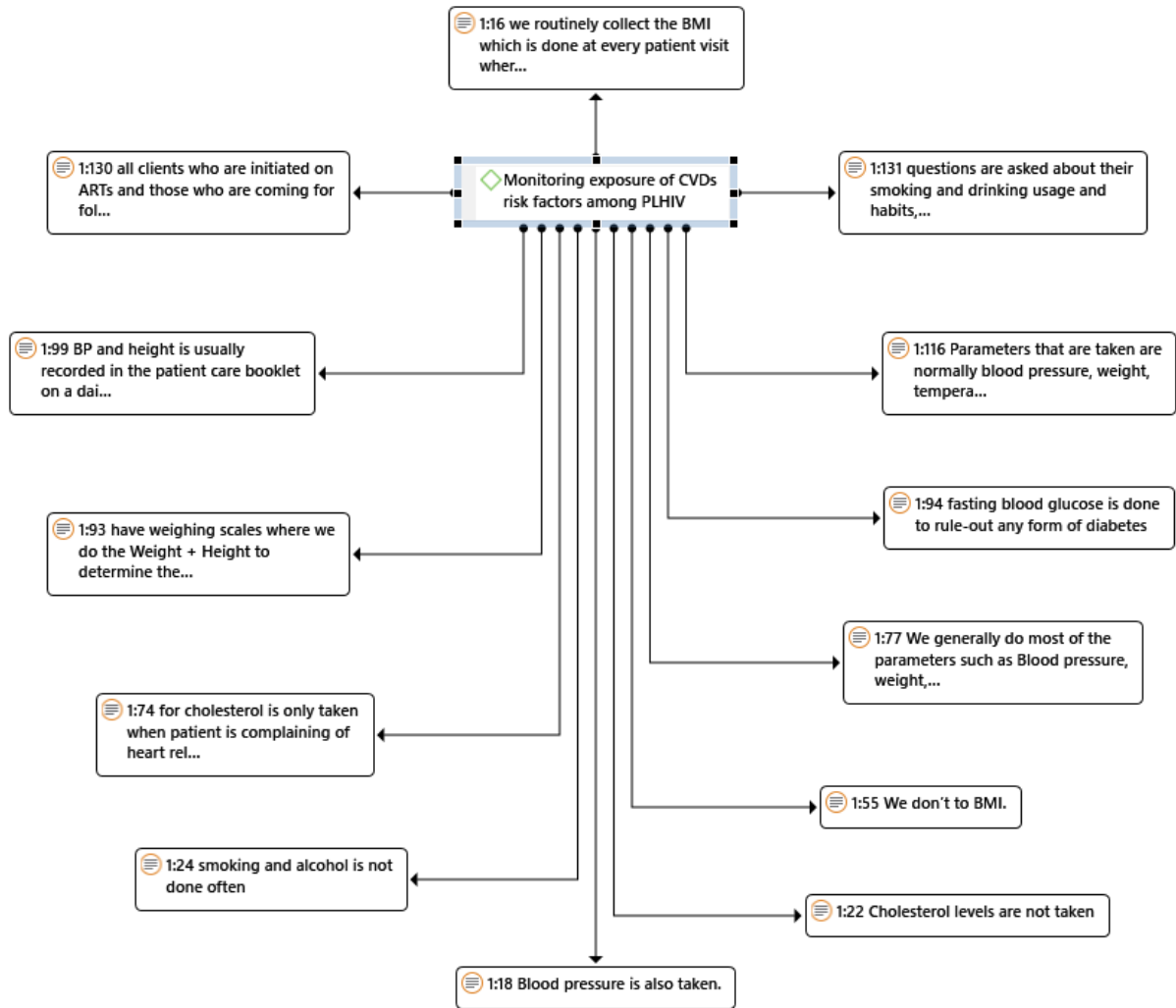
#### Sources included in the report:

Sankombo\_201301623 Mini Thesis.pdf (D45678603)  
KATONGOLE RICHARD.pdf (D43301286)  
Complete daft 3.docx (D34624791)  
KASANDA\_201182912.docx (D30223797)  
Complete thesis.docx (D35822241)  
<https://bmcpubhealth.biomedcentral.com/articles/10.1186/1471-2458-14-895>  
<https://github.com/citation-style-language/schema/raw/master/csl-citation.json>  
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[http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236\\_eng.pdf?ua=1%250Awww.who.int/about/licensing/copyright\\_form/en/index.html29](http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf?ua=1%250Awww.who.int/about/licensing/copyright_form/en/index.html29)  
[http://journals.lww.com/aidsonline/Abstract/2003/05230/Cardiovascular\\_disease\\_risk\\_factors\\_in\\_HIV.10.aspx96](http://journals.lww.com/aidsonline/Abstract/2003/05230/Cardiovascular_disease_risk_factors_in_HIV.10.aspx96)  
<http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.144.4165&rank=3166.a19dd132-95fd-4e30-ae18-865967918715>  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6615880/>

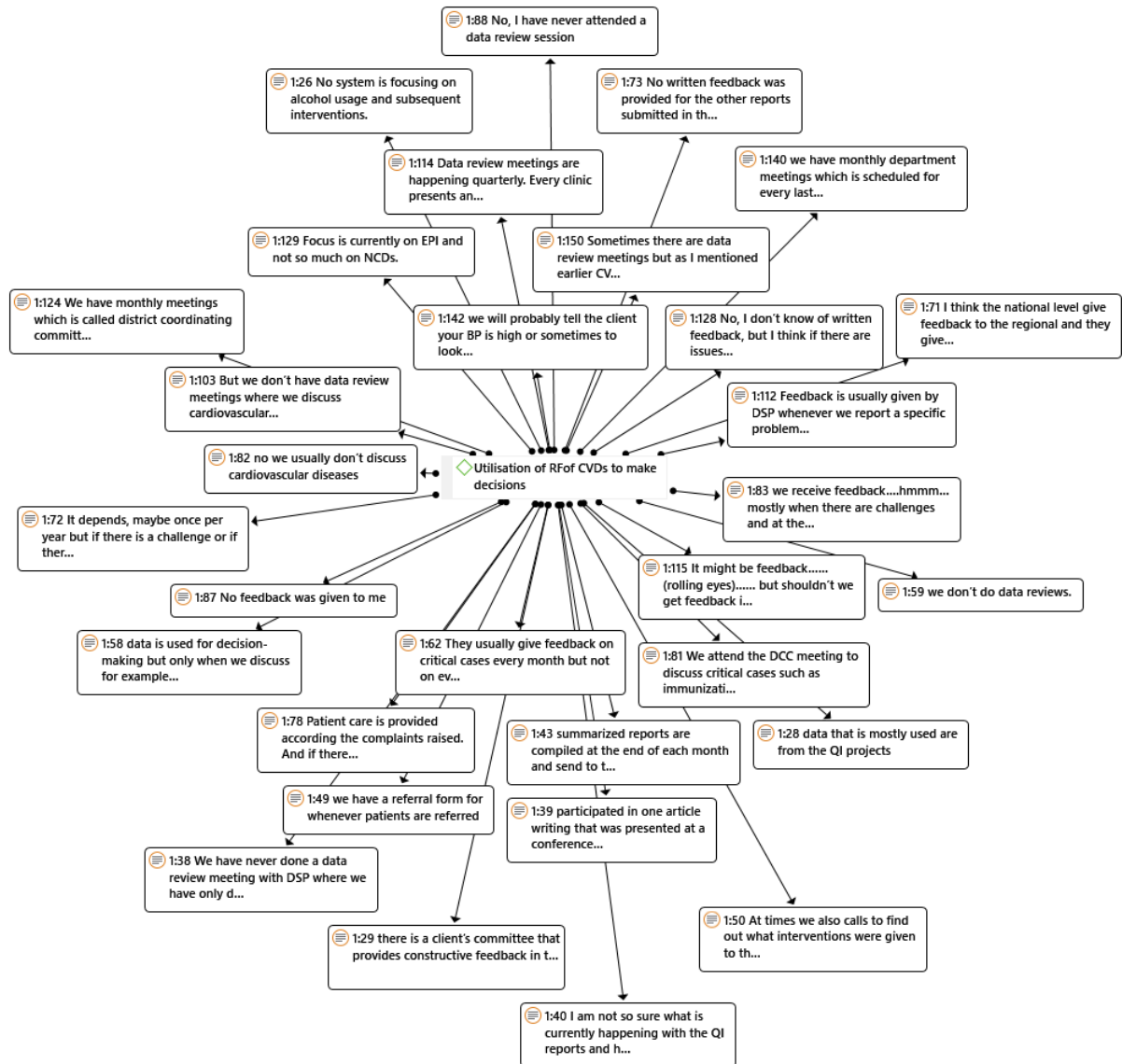
#### Instances where selected sources appear:

## ANNEXURE 11: OUTPUT FROM ATLAS.ti

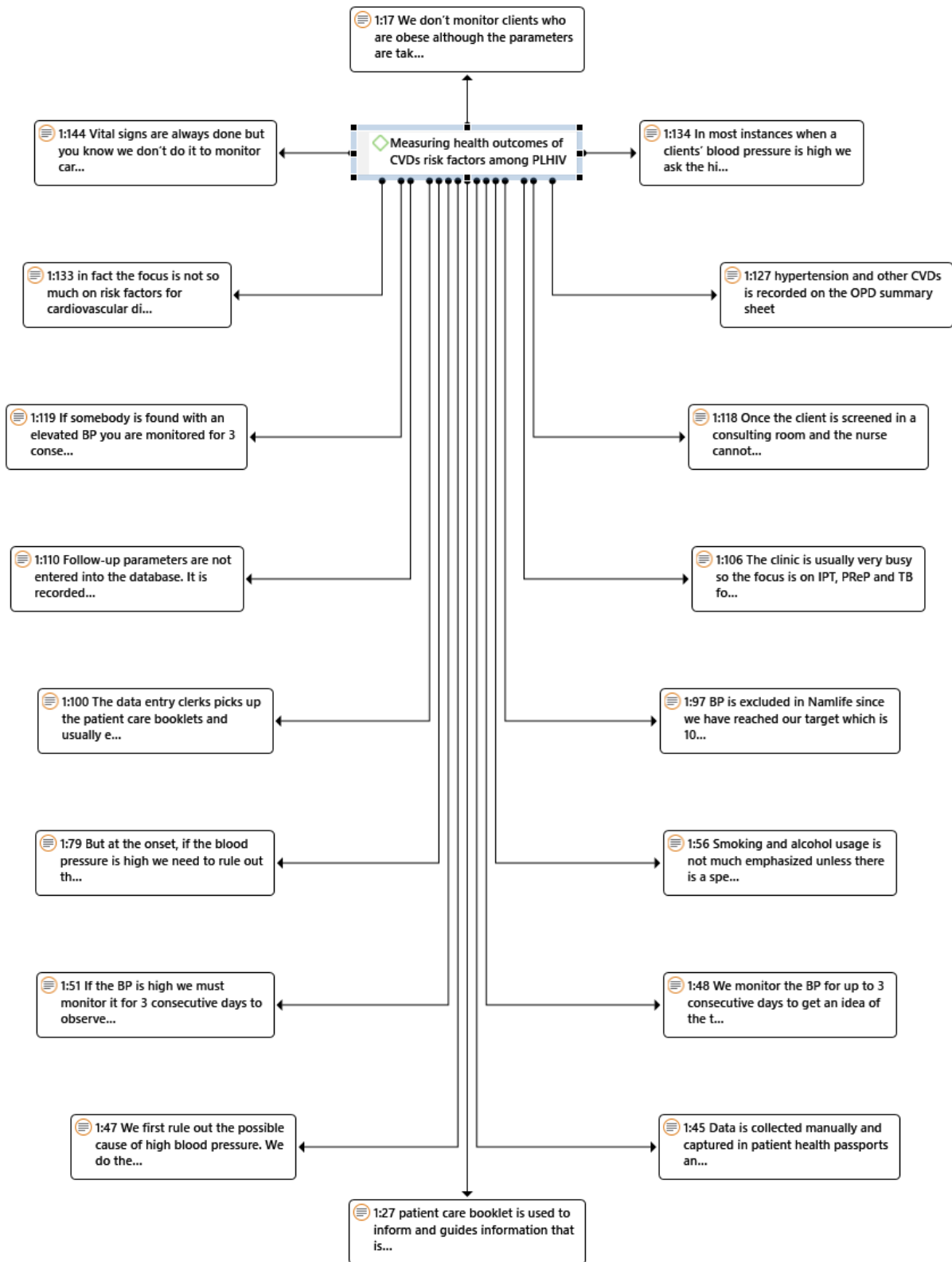
### MONITORING EXPOSURE OF CVDS RISK FACTORS



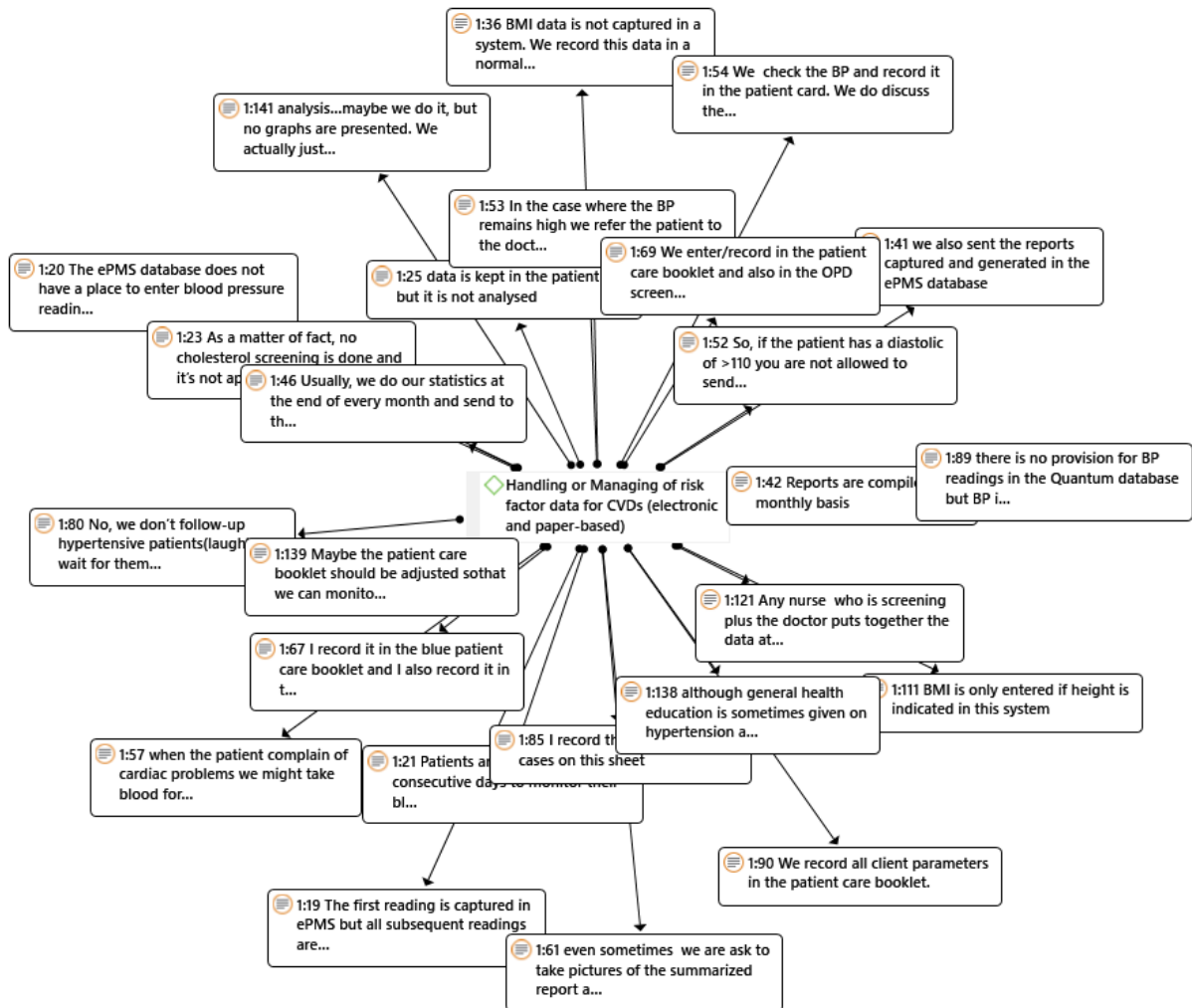
# USE OF CVDS RISK FACTORS FOR DECISION MAKING



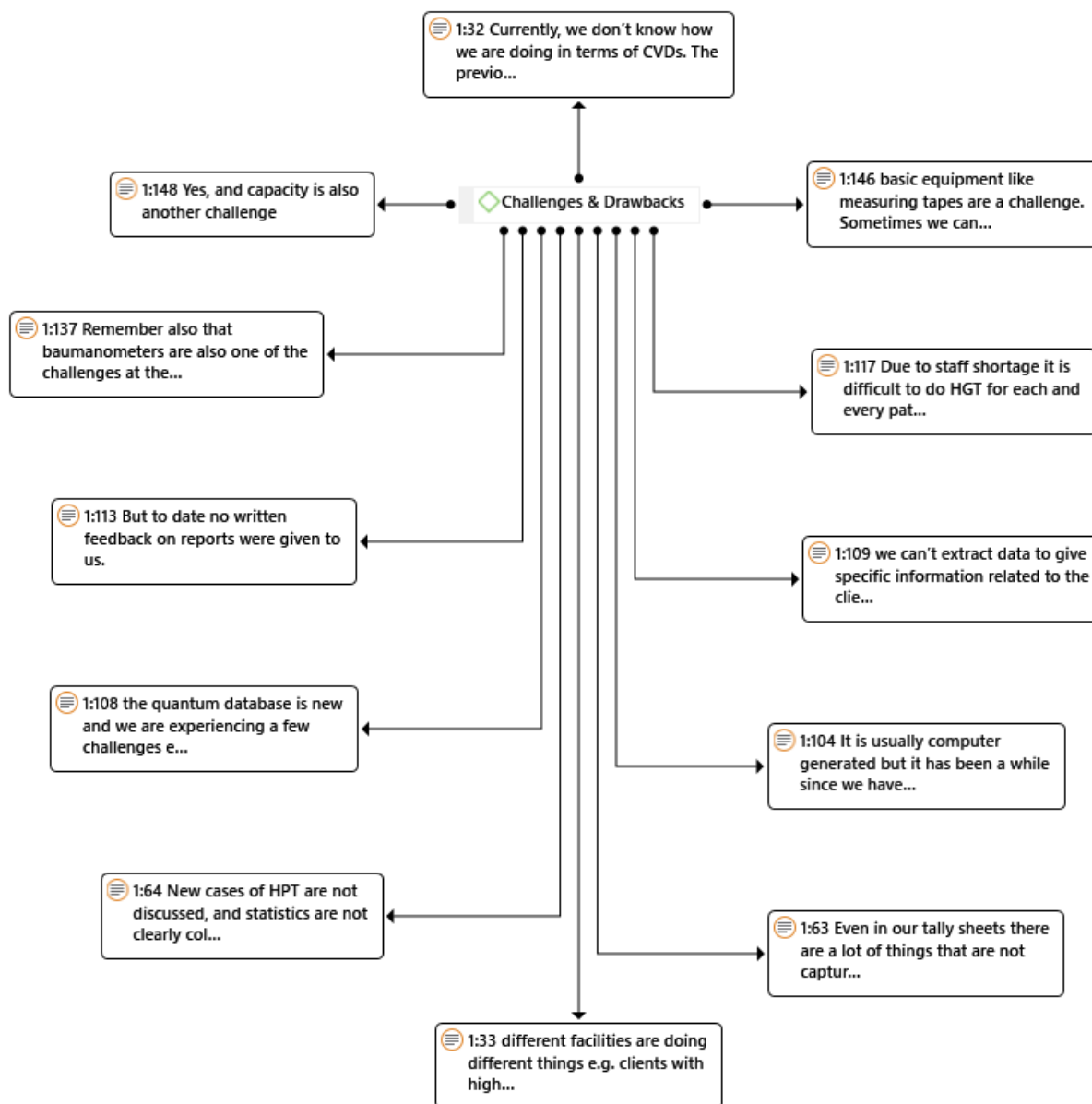
## MEASURING HEALTH OUTCOMES



## HANDLING OR MANAGING CVDS RISK FACTOR DATA



## CHALLENGES AND DRAWBACKS



## WORD CRUNCH OUTPUT FROM ATLAS.TI



## ANNEXURE 12: CONFUSION MATRIX

In order to run the logistic regression, the following library needs to be imported into the python notebook(214).

```
In [27]: import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn import metrics
import seaborn as sn
```

```
In [69]: #(use "r" before the path string to address special character, such as '\').
#Don't forget to put the file name at the end of the path + '.xlsx'
patients = pd.read_excel(r'C:\Users\Dr. Nggada\Desktop\Mahalie.xlsx')
print(patients)
```

|     | Age | Weight | Height | BP_Systolic | Admitted |
|-----|-----|--------|--------|-------------|----------|
| 0   | 47  | 51.0   | 158.0  | 100         | 0        |
| 1   | 30  | 45.0   | 165.0  | 120         | 1        |
| 2   | 26  | 46.0   | 156.0  | 110         | 0        |
| 3   | 45  | 55.7   | 175.2  | 110         | 0        |
| 4   | 40  | 47.0   | 164.0  | 150         | 1        |
| 5   | 40  | 74.0   | 165.5  | 128         | 1        |
| 6   | 40  | 74.2   | 164.0  | 100         | 0        |
| 7   | 29  | 68.0   | 165.0  | 120         | 1        |
| 8   | 48  | 71.0   | 174.0  | 130         | 1        |
| 9   | 49  | 58.0   | 184.0  | 120         | 1        |
| 10  | 35  | 34.0   | 150.8  | 100         | 0        |
| 11  | 30  | 55.7   | 147.0  | 118         | 0        |
| 12  | 24  | 71.5   | 167.5  | 110         | 0        |
| 13  | 36  | 65.4   | 177.0  | 130         | 1        |
| 14  | 24  | 71.0   | 171.0  | 140         | 1        |
| 15  | 44  | 88.8   | 159.0  | 170         | 1        |
| 16  | 38  | 46.0   | 160.0  | 116         | 0        |
| 17  | 38  | 61.0   | 174.0  | 120         | 1        |
| 18  | 51  | 56.0   | 167.0  | 130         | 1        |
| 19  | 51  | 71.3   | 166.8  | 130         | 1        |
| 20  | 35  | 70.5   | 163.0  | 110         | 0        |
| 21  | 51  | 48.0   | 166.5  | 120         | 1        |
| 22  | 32  | 59.9   | 157.0  | 110         | 0        |
| 23  | 34  | 60.2   | 180.0  | 120         | 1        |
| 24  | 35  | 68.0   | 163.0  | 110         | 0        |
| 25  | 29  | 60.7   | 166.3  | 140         | 1        |
| 26  | 43  | 74.5   | 175.5  | 160         | 1        |
| 27  | 27  | 66.6   | 158.0  | 120         | 1        |
| 28  | 29  | 72.5   | 158.0  | 100         | 0        |
| 29  | 43  | 43.5   | 155.0  | 140         | 1        |
| ... | ... | ...    | ...    | ...         | ...      |
| 499 | 41  | 59.7   | 157.0  | 162         | 1        |
| 500 | 56  | 80.0   | 154.0  | 164         | 1        |
| 501 | 28  | 47.7   | 153.6  | 164         | 1        |
| 502 | 28  | 68.6   | 163.0  | 140         | 1        |
| 503 | 26  | 69.0   | 173.0  | 159         | 1        |
| 504 | 41  | 85.2   | 154.4  | 101         | 0        |

```

27 27 66.6 158.0 120 1
28 29 72.5 158.0 100 0
29 43 43.5 155.0 140 1
... ..
499 41 59.7 157.0 162 1
500 56 80.0 154.0 164 1
501 28 47.7 153.6 164 1
502 28 68.6 163.0 140 1
503 26 69.0 173.0 159 1
504 41 85.2 154.4 101 0
505 33 52.3 159.0 106 0
506 37 61.4 171.0 142 1
507 30 56.1 168.5 142 1
508 42 52.5 157.0 138 1
509 38 54.2 164.0 110 0
510 40 75.9 166.0 165 1
511 30 67.3 168.0 110 0
512 29 63.2 180.0 130 1
513 22 42.3 153.8 114 0
514 39 65.6 158.0 139 1
515 27 58.0 175.0 124 1
516 25 67.6 156.0 137 1
517 24 66.0 152.5 143 1
518 27 73.0 175.6 123 1
519 26 70.0 160.0 153 1
520 28 38.5 165.0 158 1
521 32 85.1 179.9 138 1
522 35 51.9 166.4 119 0
523 38 61.3 153.0 87 0
524 39 45.9 152.0 114 0
525 47 74.0 155.0 97 0
526 44 62.0 177.6 115 0
527 47 54.1 156.0 120 1
528 51 53.0 158.0 162 1

```

[529 rows x 5 columns]

```
In [70]: df = pd.DataFrame(patients, columns= ['Age', 'Weight', 'Height', 'BP_Systolic', 'Admitted'])
print(df)
```

```

   Age  Weight  Height  BP_Systolic  Admitted
0    47    51.0   158.0           100         0
1    30    45.0   165.0           120         1
2    26    46.0   156.0           110         0
3    45    55.7   175.2           110         0
4    40    47.0   164.0           150         1
5    40    74.0   165.5           128         1
6    40    74.2   164.0           100         0
7    29    68.0   165.0           120         1
8    48    71.0   174.0           130         1
9    49    58.0   184.0           120         1
10   35    34.0   150.8           100         0

```

|     |     |      |       |     |     |
|-----|-----|------|-------|-----|-----|
| 11  | 30  | 55.7 | 147.0 | 118 | 0   |
| 12  | 24  | 71.5 | 167.5 | 110 | 0   |
| 13  | 36  | 65.4 | 177.0 | 130 | 1   |
| 14  | 24  | 71.0 | 171.0 | 140 | 1   |
| 15  | 44  | 88.8 | 159.0 | 170 | 1   |
| 16  | 38  | 46.0 | 160.0 | 116 | 0   |
| 17  | 38  | 61.0 | 174.0 | 120 | 1   |
| 18  | 51  | 56.0 | 167.0 | 130 | 1   |
| 19  | 51  | 71.3 | 166.8 | 130 | 1   |
| 20  | 35  | 70.5 | 163.0 | 110 | 0   |
| 21  | 51  | 48.0 | 166.5 | 120 | 1   |
| 22  | 32  | 59.9 | 157.0 | 110 | 0   |
| 23  | 34  | 60.2 | 180.0 | 120 | 1   |
| 24  | 35  | 68.0 | 163.0 | 110 | 0   |
| 25  | 29  | 60.7 | 166.3 | 140 | 1   |
| 26  | 43  | 74.5 | 175.5 | 160 | 1   |
| 27  | 27  | 66.6 | 158.0 | 120 | 1   |
| 28  | 29  | 72.5 | 158.0 | 100 | 0   |
| 29  | 43  | 43.5 | 155.0 | 140 | 1   |
| ..  | ... | ...  | ...   | ... | ... |
| 499 | 41  | 59.7 | 157.0 | 162 | 1   |
| 500 | 56  | 80.0 | 154.0 | 164 | 1   |
| 501 | 28  | 47.7 | 153.6 | 164 | 1   |
| 502 | 28  | 68.6 | 163.0 | 140 | 1   |
| 503 | 26  | 69.0 | 173.0 | 159 | 1   |
| 504 | 41  | 85.2 | 154.4 | 101 | 0   |
| 505 | 33  | 52.3 | 159.0 | 106 | 0   |
| 506 | 37  | 61.4 | 171.0 | 142 | 1   |
| 507 | 30  | 56.1 | 168.5 | 142 | 1   |
| 508 | 42  | 52.5 | 157.0 | 138 | 1   |
| 509 | 38  | 54.2 | 164.0 | 110 | 0   |
| 510 | 40  | 75.9 | 166.0 | 165 | 1   |
| 511 | 30  | 67.3 | 168.0 | 110 | 0   |
| 512 | 29  | 63.2 | 180.0 | 130 | 1   |
| 513 | 22  | 42.3 | 153.8 | 114 | 0   |
| 514 | 39  | 65.6 | 158.0 | 139 | 1   |
| 515 | 27  | 58.0 | 175.0 | 124 | 1   |
| 516 | 25  | 67.6 | 156.0 | 137 | 1   |
| 517 | 24  | 66.0 | 152.5 | 143 | 1   |
| 518 | 27  | 73.0 | 175.6 | 123 | 1   |
| 519 | 26  | 70.0 | 160.0 | 153 | 1   |
| 520 | 28  | 38.5 | 165.0 | 158 | 1   |
| 521 | 32  | 85.1 | 179.9 | 138 | 1   |
| 522 | 35  | 51.9 | 166.4 | 119 | 0   |
| 523 | 38  | 61.3 | 153.0 | 87  | 0   |
| 524 | 39  | 45.9 | 152.0 | 114 | 0   |
| 525 | 47  | 74.0 | 155.0 | 97  | 0   |
| 526 | 44  | 62.0 | 177.6 | 115 | 0   |
| 527 | 47  | 54.1 | 156.0 | 120 | 1   |
| 528 | 51  | 53.0 | 158.0 | 162 | 1   |

[529 rows x 5 columns]

```
In [71]: X = df[['Age', 'Weight', 'Height', 'BP_Systolic']]
y = df['Admitted']
```

```
In [72]: X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.25,random_state=0)
```

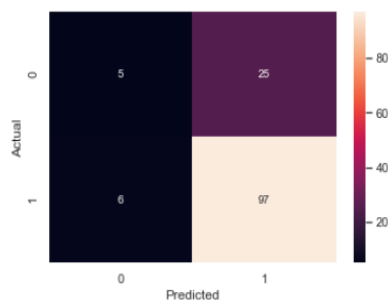
```
In [73]: #Apply the logistic regression as follows:
logistic_regression= LogisticRegression()
```

```
In [74]: #Apply the logistic regression as follows:
logistic_regression= LogisticRegression()
logistic_regression.fit(X_train,y_train)
y_pred=logistic_regression.predict(X_test)
```

C:\Users\Dr. Nggada\Anaconda3\lib\site-packages\sklearn\linear\_model\logistic.py:433: FutureWarning: Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence this warning.  
FutureWarning)

```
In [75]: #Then, use the code below to get the Confusion Matrix:
confusion_matrix = pd.crosstab(y_test, y_pred, rownames=['Actual'], colnames=['Predicted'])
sn.heatmap(confusion_matrix, annot=True)
```

Out[75]: <matplotlib.axes.\_subplots.AxesSubplot at 0x655b1c8ef0>



```
In [77]: print('Accuracy: ',metrics.accuracy_score(y_test, y_pred))
#As can be observed from the matrix:
#TP = True Positives = 97
#TN = True Negatives = 5
#FP = False Positives = 25
#FN = False Negatives = 6
Accuracy: 0.7669172932330827
```

After running the accuracy of the data, it is revealed in input 77, True Positives are rated at 97% whilst False Negatives are rated a 6%.

```
In [10]: lr.predict_proba(x_test)
```

```
Out[10]: array([[0.9022095 , 0.0977905 ],
 [0.05496599, 0.94503401],
 [0.96933165, 0.03066835],
 [0.02037938, 0.97962062],
 [0.22332253, 0.77667747],
 [0.06353309, 0.93646691],
 [0.98166896, 0.01833104],
 [0.03155015, 0.96844985],
 [0.0609876 , 0.9390124 ],
 [0.98475606, 0.01524394],
 [0.05600494, 0.94399506],
 [0.13486809, 0.86513191],
 [0.98075898, 0.01924102],
 [0.14050127, 0.85949873],
 [0.02794818, 0.97205182],
 [0.74425356, 0.25574644],
 [0.99740411, 0.00259589],
 [0.12685597, 0.87314403],
 [0.3723584 , 0.6276416 ],
 [0.97711634, 0.02288366],
 [0.02482724, 0.97517276],
 [0.13456229, 0.86543771],
 [0.02993783, 0.97006217],
 [0.91564535, 0.08435465],
 [0.94972143, 0.05027857]])
```

The accuracy of the model is tested with 5 new patients. CVDs risk is predicted which indicates, for example, that patient 1 is at risk and requires further health intervention as depicted below.

```
In [93]: #predict the risk factor of a new patient
new_patients = {'Age': [50,70,68,61,71],
                'Weight': [75,70,65,80,50],
                'Height': [160,170,165,165,175],
                'BP_Systolic': [118, 120, 110, 120, 105]
                }

df2 = pd.DataFrame(new_patients,columns= ['Age', 'Weight','Height', 'BP_Systolic'])
print (df2)
y_pred=logistic_regression.predict(df2)
print(y_pred)

   Age  Weight  Height  BP_Systolic
0   50     75    160         118
1   70     70    170         120
2   68     65    165         110
3   61     80    165         120
4   71     50    175         105
[1 1 1 1 0]
```

```
In [ ]: #interpretation
# patinet 0 should be admitted
#patient 1 to be admitted
# patient 2 to be admitted
#patient 3 to be admitted
#patient 4 to be released
```

**NB: The accuracy of this model is determined by the completeness and availability of data at the collection and collation level.**

## **ANNEXURE 13: ALTERNATIVE OPTION**

This alternative option is proposed to be further developed, implemented and tested at post-doctoral stage.

### **Integrating the surveillance and monitoring framework**

The system is created in a quite user-friendly manner, catering for advanced computer literate users to medium and low computer literate users. Java is the only programming language used in this project, with the help of its built-in application features like JavaFX. It was seen as the best choice since it can be used widely to create and run applications on servers as well as client networks. Dealing with this language made it easy to write the programme that can implement best practices and design patterns found in the Java Environment. It has become the most widely used programming language in the world as it offers some major components for successful projects. It provides object-oriented programming which is made up of attributes and codes as procedures. The Java codes are robust, as they use objects that have no references to data external to themselves or other known objects. In this way, we ensure that the instructions used in the program are only stored in the operating system of the application used (Netbeans).

### **Login Page**

This section allows individual selected staff members to login to the system with their credentials so that they can record and assess a patient's health patterns. It is also a major security feature implemented into the system in case of any type of security breaches, as you can not be able to access anything to the system without being granted permission (user has to be authorized).

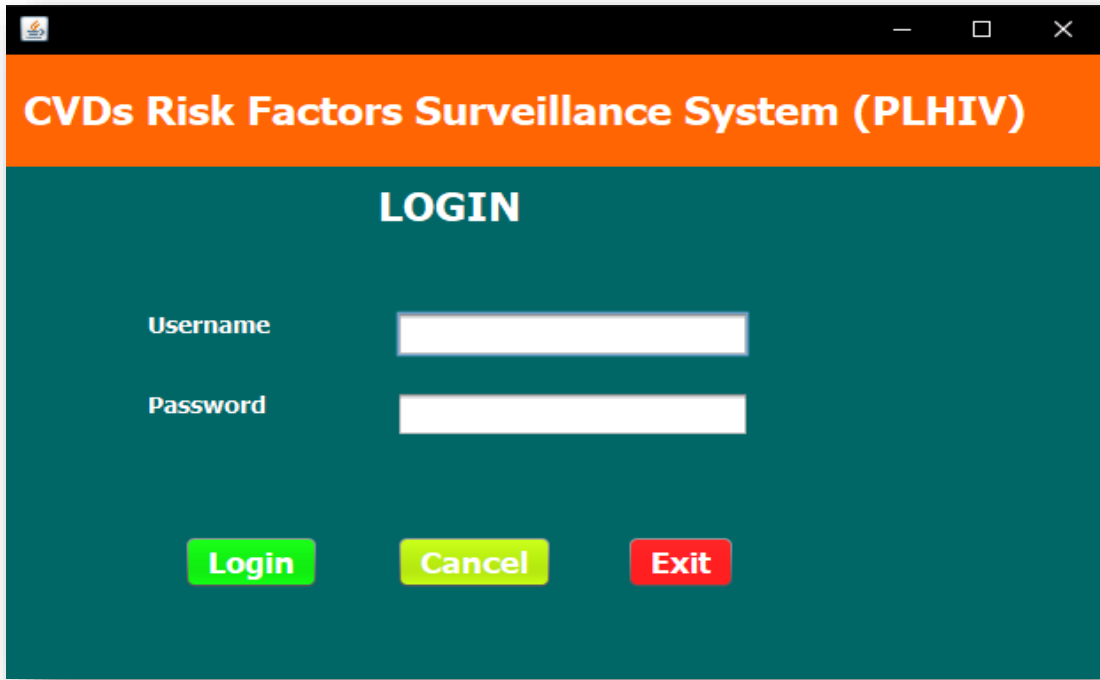


Figure 6.11: Login page

## Homepage

Below is the basic layout structure of the surveillance system.

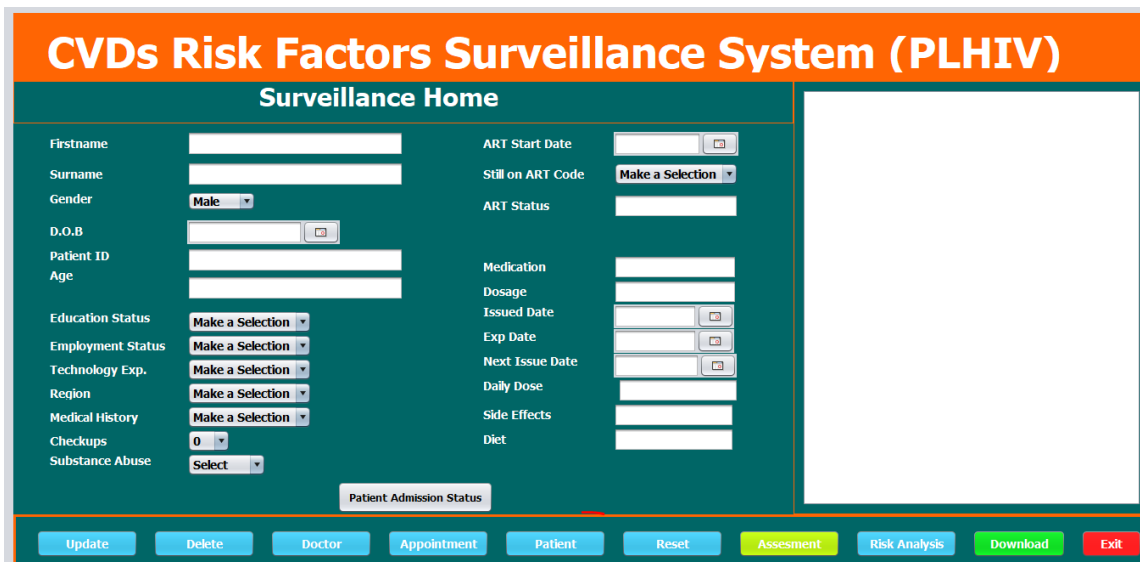


Figure 6.12: Home page of the interface

## Entering information and reviewing it

As you can notice on the screenshot below, there was the information of the patient entered in the blank spaces, under the 'Surveillance Home' panel. This information entered was instantly sent and reviewed in the big blank white space to check whether the information input was correct before save it.

The screenshot displays the 'CVDs Risk Factors Surveillance System (PLHIV)' interface. The main panel is titled 'Surveillance Home' and contains a form for entering patient data. The data entered is as follows:

| Field             | Value                   |
|-------------------|-------------------------|
| Firstname         | Thomas                  |
| Surname           | Ndapewa                 |
| Gender            | Male                    |
| D.O.B             | 04-Jul-1983             |
| Patient ID        | p12345                  |
| Age               | 36                      |
| Education Status  | High School Gr...       |
| Employment Status | Not Employed            |
| Technology Exp.   | Medium                  |
| Region            | Omusati                 |
| Medical History   | Active TB               |
| Checkups          | 0                       |
| Substance Abuse   | Alcohol                 |
| ART Start Date    | 23-Sep-2019             |
| Still on ART Code | 2                       |
| ART Status        | Substitution regimen    |
| Medication        | 2                       |
| Dosage            | zvir) + 3TC (lamivudine |
| Issued Date       | 01-Oct-2019             |
| Exp Date          | 09-Oct-2019             |
| Next Issue Date   | 15-Oct-2019             |
| Daily Dose        | 6                       |
| Side Effects      | High Blood Pressure     |
| Diet              | sum of 3 meals per day. |

At the bottom of the form, there are several buttons: Update, Delete, Doctor, Appointment, Patient, Reset, Assessment, Risk Analysis, Download, and Exit.

On the right side, there is a 'PLHIV System' panel displaying a summary of the patient's information:

PLHIV System

Patient Name : Thomas  
Patient Surname : Ndapewa  
Gender : Male  
DOB : Mon Jul 04 10:02:02 CAT 1983  
Patient ID : p12345  
Education Status : High School Grad.  
Employment Status : Not Employed  
Technology Experience : Medium  
Region : Omusati  
Medical History : Active TB  
Checkups : 0  
Substance Abuse : Alcohol  
ART Start Date : Mon Sep 23 10:01:46 CAT 2019  
Still on ART Code : 2  
ART Status : Substitution regimen  
Medication : 2  
Dosage : TDF (Tenofovir) + 3TC (lamivudine  
Issued Date : Tue Oct 01 10:01:30 CAT 2019  
Expiry Date : Wed Oct 09 10:01:33 CAT 2019  
Next Issue Date : Tue Oct 15 10:01:37 CAT 2019  
Daily Dose : 6  
Side Effects : Liver Cirrhosis , High Blood Pressure  
Diet : Balanced diet including : Cereals, Star

Figure 6.13: Surveillance system: data review

Once the information is considered to be correct, the user can print and save the information as both soft copy and hard copy.



Figure 6.14: Surveillance system: output