# Comparing Sources of Population Data in Health Information Systems

*A Case Study of Zambian Health Sector*

Fione Kusumasindra


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Department of Informatics
Faculty of Mathematics and Natural Sciences

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# Abstract

Population data plays an important role in health information systems because most health indicators require population-based data as denominators. For this reason, having reliable population data is a prerequisite for calculating quality indicators that are used for planning and evaluating health services at all levels of health systems. In many developing countries however, population data typically comes from censuses that are not conducted frequently.

This thesis is based on interpretive case study and investigates how population data is derived in Zambia, and compares population figures from different sources. It was found that census in Zambia is conducted every ten years and population projections are based on annual estimates of population growth rates since the last census. The findings show that population data is not available at the facility level in the health system. As a result, there exist different methods of estimating facility catchment population.

The comparisons of population figures are done between 3 sources (Central Statistical Office (CSO), the District Health Offices (DHOs), and PATH) at the district level, and between the DHOs and PATH at the facility level. The findings demonstrate that the district level population comparisons do not show large differences except for the districts that were affected by district splitting. On the other hand, extreme differences were found in the facility level population comparisons where the largest discrepancy is 1973.27%, while the lowest is 0.11%. The methods for estimating facility catchment population were observed to be different between the DHOs and PATH.

This thesis contributes by discussing implications of having different methods to estimate catchment population and raises a concern that by having different catchment population estimates could make the calculation of health indicators become less reliable.

**Keywords**: population data, catchment population, facility population, health facility catchment

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*Fione Kusumasindra*
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# Abbreviations

| | |
|---|---|
| AFDB | African Development Bank |
| AIS | AIDS Indicator Survey |
| ANC | Antenatal Care |
| CHAZ | Churches Health Association of Zambia |
| CHW | Community Health Worker |
| CPR | Central Population Register |
| CRVS | Civil Registration and Vital Statistics |
| CSO | Central Statistical Office |
| DCMO | District Community Medical Officers |
| DHIO | District Health Information Officer |
| DHIS2 | District Health Information System 2 |
| DHMT | District Health Management Team |
| DHO | District Health Office |
| DHP | District Health Planner |
| DHS | Demographic and Health Survey |
| FAMS | Financial and Administrative Management System |
| GDP | Gross Domestic Product |
| GIS | Geographic Information System |
| GSM | Global System for Mobile Communication |
| HAA | Hospital Activity Analysis |
| HIS | Health Information Systems |
| HISP | Health Information System Program |
| HMIS | Health Management Information System |
| HRMS | Human Resource Management System |
| ICT | Information and Communication Technology |
| IDSR | Integrated Disease Surveillance and Response |
| IS | Information System |
| LCMS | Conditions Monitoring Survey |
| LMIS | Logistics Management Information Systems |
| MCDMCH | Ministry for Community Development and Mother and Child Health |
| MDG | Millennium Development Goal |
| MDGI | Millennium Development Goal Initiative |
| M&E | Monitoring and Evaluation |
| MFL | Master Facility List |

| | |
|---|---|
| MIS | Malaria Indicator Survey |
| MOH | Ministry of Health |
| NGO | Non-governmental Organization |
| NHC | Neighborhood Health Committee |
| NHS | National Health Service |
| OMR | Optical Mark Reading |
| OPD | Outpatient Department |
| PES | Post Enumeration Survey |
| PIN | Personal Identification Number |
| R&D | Research and Development |
| RHA | Regional Health Authority |
| RHC | Rural Health Center |
| SDG | Sustainable Development Goal |
| STI | Sexually Transmitted Infection |
| TB | Tuberculosis |
| THPAZ | Traditional Health Practitioners Association of Zambia |
| UHC | Universal Health Coverage |
| UiO | University of Oslo |
| UKAID | United Kingdom AID |
| UNFPA | United Nations Population Fund |
| USAID | United States Agency for International Development |
| ZDHS | Zambia Demographic and Health Survey |

# Chapter 1

# Introduction

The first section of this chapter presents motivation for why this thesis was written. The next section presents the research questions this thesis seeks to answer. A brief introduction to the context of the research is presented afterwards which describes where and when the study was conducted. Finally, overview of the thesis will be given.

## 1.1 Motivation

Population data provides essential facts to the government for planning and policy-making. The government makes decisions that facilitates the welfare development of the people and thereby it provides meaningful gauge of for example, how many people who live in a defined area and need public services such as health, education, and transportation. Population data has become essential for health provision. For instance, population size and characteristics can influence the location and the size of health facilities that satisfy the needs of target population (Doherty, Rispel, and Webb, 1996). Effective health provision can be ascertained through working knowledge of the number of population at all health management levels, particularly at facility level. Each health facility functions as the first contact with patients, therefore *"each facility must know the population it serves and where that population lives"* (Heywood and Rohde, 2001). However, determining facility catchment population can be complicated.

Having accurate population data is a prerequisite for producing quality indicators. Health providers have become increasingly focused on the quality of the care they provide and thus they need a measurement to asses it such as health indicator. Health indicators can support various kinds of decision makers such as facility, district, and province health authorities as they monitor the health status of their population and assess the performance of their local health systems. Here, population data has a significant role because many indicators require population data as the denominator in the calculation (Hearle, 1970). According to Lippeveld et al (2000) there are four types of indicators. Ratio, proportion, and rate indicators for example, are the types of indicators where population data serves as denominator. For example, in order to calculate HIV prevalence rate, the numerator is the total of infections and the required denominator is the total population (WHO, 2015a).

Another example is for calculating immunization coverage indicator for children under 1 year. The numerator is the number of the children under 12 months given specific vaccine and the required denominator is the total number of children under 12 months (WHO, 2015a). Additionally, coverage indicators are used to measure a specific program performance at lower levels in health system. For example, a health facility needs to calculate indicators linked to targets for immunization (Braa and Sahay, 2012). If the statistics on the catchment population being served by the program or facility is available, coverage indicators can be estimated (Okonofua, 2014).

Population data and its characteristics can be obtained through various sources with the primary source being the census. A census is among the most complex tasks a country undertakes. The role of population and housing census is to collect and process detailed statistics on population, its characteristics, composition, spatial distribution and organization (households and families) (United Nations, 2008). When it comes to conducting population census, many African countries face a great deal of challenges, such as in Nigeria and Gambia (Mba, 2004, Ezeah, Iyanda, and Nwangwu, 2013). Nigeria does not have effective and reliable census data because it is affected most likely by shortage of resources, political reasons, and wrong perception of headcounts as battle platform for inter-ethnic competition (Ezeah, Iyanda, and Nwangwu, 2013). A study in Gambia indicated problems related with the failure to enumerate all people that led to incomplete data and false estimates for people at particular age groups (Mba, 2004). Censuses require huge amount of time and manpower, and as a result, many countries have outdated information. Irregular updates on population data may lead to inaccurate assumptions which then shape inappropriate policies.

As one of the developing countries, Zambia also experiences challenges in undertaking censuses and yet the country requires reasonably accurate statistical information on population data for effective development planning in many areas, with health sector being one of them. Census data is the principle source of information on population data in Zambia, but censuses are undertaken only once per decade and then it takes additional time to be analyzed and released. From then, government organizations who need data on population will rely on the annual projections based on population growth estimates. It should be stressed that estimating projections is subject to some degree of uncertainty. The accuracy of population data gets weaker as it further departs from the time the census was originally taken. Estimation originated from another estimation will never be accurate (Sahay, Sundararaman, and Braa, 2017). Thus, this has become an issue for health sector in Zambia. Calculation of indicators could be affected as using inaccurate population as denominator may cause the information being less appropriate for making informed decisions. Furthermore, population data is not available at all levels of health

information system in Zambia. It could cause the health providers being not always able to plan the health service delivery and serve the actual population adequately.

According to Heywood and Rohde (2001), "*the census is good for larger catchment populations at national, provincial, district and even sub-district or magisterial level"*. As is the case in Zambia, the population data is only available at national level, provincial level, and district level. The absence of population data at the facility level have prompted methods with the objective of estimating the number of people each facility serves, namely catchment population, by making use of available census data. Addressed in Heywood and Rohde (2001), "*population figures have usually not been considered important in the past and this information is therefore often not available at facilities"*, and yet facility catchment population is one of the major inputs for health indicators (Hearle, 1970). Catchment population should be of major interest for health facility managers as they need to monitor the programs and activities which are performed with respect to their targets (Braa and Sahay, 2012).

Challenges of providing quality population data in Zambian health sector serves as the motivation of this thesis. District health offices has undertaken an effort to estimate facility catchment population and therefore this thesis sets out to investigate the methods used to estimate facility catchment population and compare catchment population figures derived from different methods and sources. In addition, the phenomenon of estimating catchment population has received little previous attention from researchers and therefore examples of previous studies and literature on this particular topic are limited. Research on this topic could potentially help and contribute to the work of particular groups such as policy and decision makers, researchers, and implementer. I believe discussing more on this topic could increase the understanding of the importance of population data in health sector.

## 1.2 Research context

This thesis is conducted under Information System (IS) research group and is part of Health Information System Program (HISP), a global network established and based at the University of Oslo. HISP works with the objectives of strengthening health information systems (HIS) in developing countries. Among others, Zambia is one of the countries that has received support from HISP and many other organizations in order to improve its HIS. Akros is a Non-governmental organization (NGO) based in Lusaka, Zambia who has a partnership with HISP and therefore this research was also carried out with the support from Akros who facilitated the field work in Zambia.

The field work was conducted over one-month period during October – November 2016 in in Lusaka. Zambia was chosen after consideration of the accessibility. The scope of the thesis centers on Zambian health sector that is organized by the Ministry of Health

(MOH) and focuses on population data at facility level and district level. As previously mentioned, one of the objectives is to compare population figures and this is done between two sources: population data provided by the District Health Office (DHO), and population data provided by PATH. PATH is an NGO who has worked with the government of Zambia to resolve challenges in health sector since 2005 and leads a number of projects ranging from malaria to immunization program. Also important to this thesis is addressing the census. Central Statistical Office (CSO) is the official government organization who conducts the census in Zambia. Therefore, DHO, PATH, and CSO are sources or main actors that are focused on in this thesis.

## 1.3 Research questions

The purpose of this thesis is to address the challenges of estimating population data used in health information system in Zambia with particular focus on facility and district level. The overall objective is to highlight the differences between population figures coming from different sources who provide population data for health sector.

The research questions for this thesis are therefore formulated as follows:

- *How are different sets of population data in Zambia derived?*
- *How do population figures from different sources compare to each other?*

## 1.4 Chapter overview

*Chapter 2 – Background* presents an overview of Zambia's profile including the health status, infrastructure, and economic conditions. This chapter also describes health sector organization in Zambia, as well as the coordination of HIS and HMIS.
*Chapter 3 – Relevant literature* presents literature used as conceptual background for this thesis. Firstly, the chapter will present the role and status of population data to describe the importance of having quality population data. Secondly, the definition of catchment population is provided. Thirdly, as the problem area of this thesis, literature on HIS will be presented including common challenge of HIS in developing countries. Finally, literature on census and vital registration is provided.
*Chapter 4 – Methodology* presents the research approach and chosen methodology of this thesis. This chapter describes various data collection methods used for the study as well as data analysis techniques. Reflection upon the research is provided in the last section.
*Chapter 5 – Findings* presents the findings from the field work and research conducted.

*Chapter 6 – Discussion* discuss the findings that are presented in Chapter 5, including the implication of these findings. In light of the research questions, findings will also be discussed using literature presented in Chapter 3.
*Chapter 7 – Conclusion* presents summary of the discussion and the answers for the research questions. Research contributions and suggestions for future work within this field will conclude the chapter.

# Chapter 2

# Background

The purpose of this chapter is to provide an understanding of the research context. This chapter starts with presenting a situation analysis of the country Zambia. This analysis includes insight to the present geography, demography, socio-economic status, infrastructure, and health status. Current situation in these sectors may influence the health sector performance and health care delivery. Providing an overview of these backgrounds will help readers to understand the factors that may affect Zambian health sector direct or indirectly. In addition, a brief overview of the HIS in Zambia will be provided, followed by an overview of health system organization. An introduction to the Health Management Information System (HMIS) is also presented. Finally, the chapter briefly presents the HISP, a research program in the University of Oslo under which this research is conducted.

## 2.1 Overview of Zambia

### 2.1.1 Geography, demography, and socio-economic status

Figure 2.1 – Location of Zambia in Africa

Located in sub-Saharan Africa, Zambia is a landlocked country that borders Democratic Republic of Congo to the north, Tanzania to the northeast, Malawi and Mozambique to the east, Zimbabwe and Botswana to the south, Namibia to the southwest, and Angola to the west. The capital city is Lusaka, located in the south-central part of Zambia. The country covers a land area of 752,612 square kilometers. Zambia has a tropical climate and vegetation with three different seasons: a hot dry season during September and October, a warm wet season from November to April, and the cool dry winter during May and August.

Administratively, Zambia is divided into provinces, districts, constituencies, and wards. At the time of the census, Zambia had 74 districts, 150 constituencies, and 1,430

wards. As of 2016, Zambia has 103 districts in total. Out of 10 provinces, the population is concentrated predominantly around two, namely Lusaka Province and Copperbelt Province. Besides being the most densely populated provinces, Lusaka and Copperbelt are also the most urbanized. The remaining provinces are mainly rural.


**Figure 2.2 – Map of Zambia with provinces** (United Nations, 2004)

The census reported a total population of 13.1 million in 2010 and annual population growth rate of 3%. During 2000 and 2010, the population growth rates also varied by province ranging from 2% in Western and 5% in Lusaka (CSO et al., 2014). The census also reported a life expectancy of 49 years for males and 53 years for females in 2010. The population density increased from 8 people per square kilometer in 1980 to 17 in 2010. Average density by province ranged from as high as 100 people per square kilometer in Lusaka to as low as 6 people in North Western. In 2015, the total population in the country has reached 16.2 million (African Health Observatory and WHO, 2016).

Zambia is a lower middle-income country that aims at becoming a prosperous middle-income country by 2030. Zambia has a mixed economy consisting a modern urban sector that geographically follows the rail line, and a rural agricultural sector. CSO reported in 2014 that construction sector contributes 14% of the gross domestic product (GDP), agriculture contributes 9% of GDP, as well as manufacturing and mining sector each

contributes 8% of GDP (CSO et al., 2014). Historically, during the decade following independence (1965-1970), Zambia's economy has been based on the copper mining industry that contributes 45% of government revenues and 95% of annual export earnings. However, in the mid-1970s, copper and oil prices declined sharply causing the deterioration of Zambia's economy. Vigorous adjustments were applied but failed to significantly alter the economy situation and led to increased levels of poverty (CSO et al., 2014).

The country recorded improvements in economic performance between 2006 and 2011 with the average economic growth rate at above 5% (Ministry of Health, 2011). The World Bank[1] reported GDP grew at 2.9% in 2015 and 3.4% in 2016, a descent from the average of 7.4% between 2004 and 2014. Due to its socio-economic status, poverty in Zambia remains high and widespread. In 2015, 54.4% of the population were categorized as poor and 40.8% of the population were living in extreme poverty (Smith and Chinzara, 2016). The poverty is mainly a rural phenomenon with 77% of the poorest households located in rural areas (Smith and Chinzara, 2016).

The Zambian health sector is donor dependent. In 2006, 42% of the funding comes from donors and 24% comes from the government, with the rest coming from households, employers, and others.

### 2.1.2 Infrastructure

Population and economic activity in Zambia are heavily concentrated along the central Copperbelt and Lusaka provinces. The development of infrastructure such as power and information and communications technology (ICT) seems to mirror this economic geography trend. As a result of overinvestments in some areas, the far-east and west parts of the country tend to be in the poorest condition (Foster and Dominguez, 2010). Infrastructure condition affects how program interventions and activities from different sector perform in Zambia, such as health sector. Effective HMIS relies on working ICT and electricity for entering data, accessing data, and giving feedback. The road networks are important for facilities to transport the data to the districts. Similarly, health and demographic surveys are also dependent on the road condition for surveyors or health community workers to visit households and families.

Unequal coverage exist in Zambia's road infrastructure. The road networks in rural areas seem to be neglected thus the condition of the existing roads remains inadequate (Foster and Dominguez, 2010). For the core road network, 60% are in dire need of critical rehabilitation (Muya et al., 2017). However, funding for maintenance continues to be the main challenge.

[1] http://www.worldbank.org/en/country/zambia/overview

27.9%[2] of population in Zambia has access to electricity in 2014. 0.5% of population is newly electrified per year (Foster and Dominguez, 2010). There is urgent need for rehabilitation of the power stations across the country. Bigger challenge is present in the power distribution system. The distribution system has not been able to cope with the increase in the number of customers, because parts of it are old and in a need of immediate replacement and expansion. Inadequate infrastructures in terms of electricity have therefore contributed to power outages in Zambia. Power outages are common with frequency and duration that vary. Health facilities experience power outages ranging from 5 to 8 hours a day. Backup generators have become the solution for many years even though sometimes they run out of fuel.

In terms of ICT, Zambia has experienced a rapid growth in mobile technology usage, with 71 out 100 people reportedly using these technologies (UNDP, 2016). Global System for Mobile Communication (GSM) coverage is limited with 53% of population living within range of GSM signal (Foster and Dominguez, 2010). However, internet access and mobile services remain low despite the huge mobile phones penetration. The cost appears to be the barrier to gain access to internet and mobile services. Additionally, the price of devices and equipment such as internet-enabled mobile phones and personal computers is excessively high (UNDP, 2016).

### 2.1.3 Health status

The disease burden in Zambia is high and mainly caused by the high prevalence of communicable diseases, especially human immunodeficiency virus /acquired immunodeficiency syndrome (HIV/AIDS), malaria, tuberculosis (TB), and sexually transmitted infections (STIs). The epidemic of HIV and AIDS has significantly impacted the morbidity and mortality level across the country. Additionally, malaria reportedly had been the leading cause of morbidity and mortality in Zambia from 2006 to 2008 with deaths averaging 50,000 per year (Ministry of Health, 2011).

Zambia is among the countries with the highest maternal and child mortality levels in the world. During the period of 2009 to 2014, neonatal mortality rate was at 24 deaths per 1,000 live births. 5 years preceding above period, the infant mortality rate was at 45 deaths per 1,000 live births which means that 1 in every 22 children died before reaching age 1. For the same period, under-5 mortality rate was at 75 deaths per 1,000 live births which means 1 in every 13 children did not survive to the fifth birthday (CSO et al., 2014). Since the Millennium Development Goals (MDGs) were created, there has been progress in reducing child mortality, improving maternal health and fighting diseases particularly

[2] The World Bank - Access to electricity (%population) https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS

HIV/AIDS, malaria, and others. The reported declines in mortality rates and diseases however, were insufficient for Zambia to achieve the MDGs target by 2015. The table below summarizes some of the achievements in comparison with the 2015 MDGs target.

**Table 2.1 – Progress indicators towards MDGs target** (UNDP, 2013)

| **Indicators** | **2002** | **2007** | **2010** | **2015** | **MDG target** | **Progress Status** |
|---|---|---|---|---|---|---|
| *Under-5 mortality rate (deaths per 1000 live births)* | 168 | 119 | 137.6 | 64 | 63.6 | Not achieved |
| *Measles immunization coverage among 1-year-olds (%)* | 84 | 84.9 | 94 | 85 | 100 | Not achieved |
| *Maternal mortality ratio (deaths per 100,000 live births)* | 729 | 591.2 | 483 | 224 | 162.3 | Not achieved |
| *HIV prevalence rate (%)* | 15.6 | 14.3 | - | - | 15.6 | Achieved |
| *New malaria cases per 1000 population* | 388 | 358 | 330 | - | 255 | Not achieved |
| *Malaria fatality rate per 1000 population* | 48 | 40 | 34 | - | 11 | Not achieved |

Although some of the MDGs goals were not achieved, the progress in the Zambian health sector indicates promising result towards reaching the goals of Sustainable Development Goals (SDGs) 3 – Ensure healthy lives and promote well-being for all at all ages by 2030. Universal health coverage (UHC) is one of the health targets. Some of the SDG 3 targets among others include:

- reduce maternal mortality ratio to less than 70 per 100,000 live births,
- reduce neonatal mortality to at least as low as 12 per 1000 live births,
- reduce under-5 mortality to at least as low as 25 per 1000 live births, and
- End the epidemic of AIDS, TB, malaria and other communicable diseases.

## 2.2 Health sector organization

The health sector in Zambia is diverse in terms of ownership, which can be divided into:

- public health sector under the Ministry of Health and some of the government line ministries and departments,
- faith-based health sector under Churches Health Association of Zambia (CHAZ),
- private health sector both for- and non-for profit under private investors and Civil Society Organizations, and
- Traditional and alternative health service providers who run informally and are not monitored and regulated by the Ministry of Health.

The following table presents the statistics of health facilities in Zambia based on different types of ownership as recorded in 2012.

**Table 2.2 – Statistics for health facilities by province in Zambia** (Ministry of Health, 2013)

| **Province** | **Number of health facilities by ownership** | | | **Total** |
|---|---|---|---|---|
| | **Public health facilities** | **Mission health facilities** | **Private health facilities** | |
| Central | 185 | 9 | 10 | 204 |
| Copperbelt | 172 | 10 | 68 | 250 |
| Eastern | 193 | 13 | 0 | 206 |
| Luapula | 138 | 6 | 1 | 145 |
| Lusaka | 126 | 13 | 155 | 294 |
| Muchinga | 89 | 7 | 3 | 99 |
| Northern | 139 | 6 | 3 | 148 |
| North-western | 143 | 18 | 2 | 163 |
| Southern | 227 | 18 | 8 | 253 |
| Western | 178 | 16 | 0 | 194 |
| **Total** | 1590 | 116 | 250 | 1956 |

Traditional health providers are arranged under the Traditional Health Practitioners Association of Zambia (THPAZ). The population that use traditional and alternative services is estimated about 80%. There has been no strong legal policy to control the use of traditional medicines despite numerous complaints of malpractices (Ministry of Health, 2012). The government has been working on strengthening the legal framework, supervision, and research in this sector to ensure safe provision and health services based on evidence to the communities.

### 2.2.1 Core health facilities

The health services are delivered through five levels of health care as follow:

- Health posts, are the lowest level of health care and typically are built in communities that are distant from health centers, usually arranged within 5km radius for sparsely populated regions. They provide for catchment population of around 7,000 in urban areas and 3,500 in rural settings. Services offered include basic first aid rather than curative.
- Health centers, intended to serve as primary care centers, comprised of rural health centers (RHC) and urban health centers (UHC). RHCs cater for catchment population of approximately 10,000 or catchment areas within 29km radius, while UHCs serve a population of between 30,000 to 50,000 people.
- First level hospitals, usually referred to as District Hospitals are expected to serve a catchment population of 80,000 and 200,000. Services offered include medical, surgical, pediatric, obstetrics and diagnostic service, and also all clinical services related to support of health center referrals.
- Second level hospitals, also referred to as General Hospitals or Provincial Hospitals should provide for a population of between 200,000 and 800,000 people. Services offered are general surgery, internal medicines, dental, pediatrics, obstetrics and diagnostic services, psychiatry and intensive cares. These hospitals are also referral for the first level hospitals. Additionally, trainings and technical backup are provided here.
- Third level hospitals, as referred to as Tertiary Hospitals or Specialist Hospitals have sub-specializations in services that are offered in second level hospitals. Additionally, these hospitals conduct training and research. Third level hospitals shall attend to complicated cases referred by second level hospitals.

### 2.2.2 Health sector coordination

The structure of Zambian health system has been subject to considerable changes with a first process of decentralization in 1990s and then was redefined in 2006. The process has resulted in the creation of boards, teams, and committees from the central level down to the facility level. The Ministry of Health is responsible for overall coordination and management of the health sector in Zambia. The following table shows the coordination structures that have been established at national, provincial, district, and community levels. Additionally, Figure 2.3 illustrates the organizational chart consisting of bodies or organizations that are involved in the coordination of health sector, as well as parts or structures that are managed at each level.

**Table 2.3 – Structures and responsibilities in Zambia's decentralized health system**
(African Health Observatory and WHO[3])

| Health System Level | Committees | Responsibilities in Health |
|---|---|---|
| National level | Ministry of Health | Policy & regulation |
| | Central Board of Health | Implementation and purchaser of services (through contacting with District Health Management Team (DHMT) and Hospital Management Team |
| Provincial level | Provincial Health Office | Give technical guidance, support & monitoring. Administrative link between central & district |
| District level | District Health Management Team<br>Hospital Management Team | Technical support to the provision of services<br>Support to hospital management |
| | District Health Board<br>Hospital Management Board | Strategic orientation, decision making |
| Community level | Health Center Committees | Community participation to the management of health centers |
| | Neighborhood Health Committees (NHCs) | Community participation in health |

[3] Zambia country profile - http://www.aho.afro.who.int/profiles_information/index.php/Zambia:Index

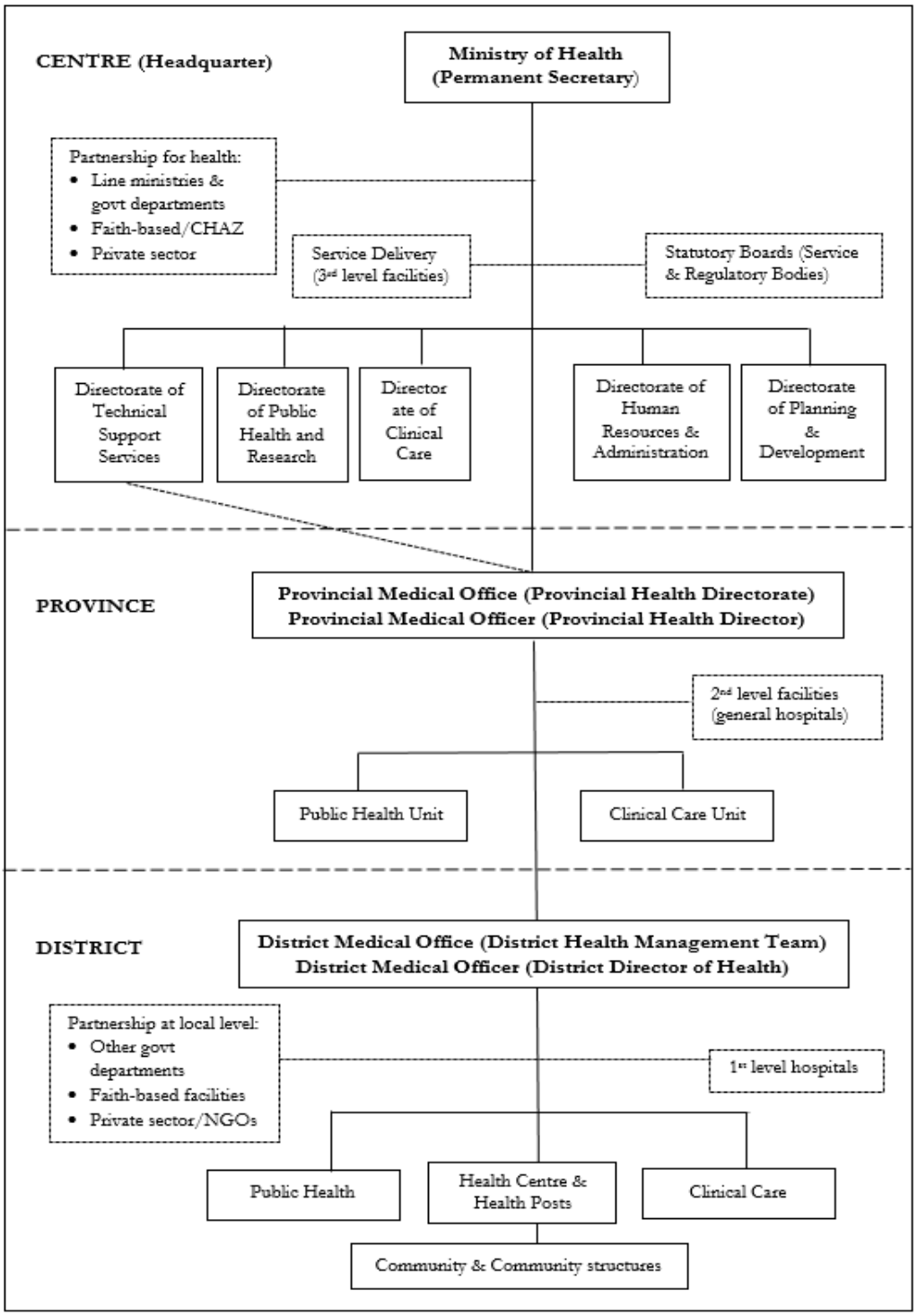


**Figure 2.3 – Organizational chart of health sector coordination in Zambia** (African Health Observatory and WHO[4])

[4] Zambia country profile - http://www.aho.afro.who.int/profiles_information/index.php/Zambia:Index

## 2.3 Health Information Systems in Zambia

Zambia has developed a health information system that provides information for program planning, monitoring, and evaluation. This health information system comprises various players within the health sector including donors and is coordinated as a part of national monitoring and evaluation. Health information system includes all resources, actors as well as organizations that are involved in policy making and regulations, financing, and provision. Health information system also includes different users and uses of information. The system consists of routine sources of information and non-routine sources of information (as presented in Table 2.3). The Ministry of Health is at the helm of overall management and coordination of the health sector in Zambia and with the support of various stakeholders, have worked together in the development and strengthening of health information system at different levels of the health system (Ministry of Health, 2012).

**Table 2.4 – Health information systems in Zambia** (Ministry of Health, 2007, Akros, 2016)

| Health Information Systems | Purpose | Location and Actors |
|---|---|---|
| HMIS | Routine health information and integrated data warehouse | District health offices, facilities. Responsibility of: Directorate of Planning & Development of MOH |
| Integrated Disease Surveillance and Response (IDSR) | Disease surveillance to reduce the impact of epidemics associated with mortality & morbidity, IDSR compliments the HMIS, | District health offices, facilities. Responsibility of: Directorate of Planning & Development of MOH |
| Financial and Administrative Management System (FAMS) | Provide simple but comprehensive and accountable financial & administrative management. All districts operating on the cash book, a system of ledgers & forms | Districts. Responsibility of: Directorate of Planning & Development of MOH |
| Integrated Human Resource Management System (iHRMS) | Human resources capital | Districts. Responsibility of: Directorate of Planning & Development of MOH |

| | | |
|---|---|---|
| Logistics Management Information Systems (LMIS) | Commodities data management for HIV/AIDS, TB, Maternal and Child Health, Reproductive and Family Planning | Districts. Responsibility of: Directorate of Planning & Development of MOH |
| SmartCare | Individual patient level data capturing and storage system for ARTs, TB, VCT, PMTCT and Electronic records | District health offices, facilities. Responsibility of: CDC, MOH |
| Zambia Demographic and Health Survey (ZDHS) and Living Conditions Monitoring Survey (LCMS) | Collect data on mortality, morbidity, determinants of health, socio-economic status, coverage and access, health seeking behavior, disease prevalence | National. Responsibility of: CSO and M&E unit of MOH |
| Census of Population and Housing | Collect data on number of population and its characteristics | National. Responsibility of: CSO and M&E unit of MOH |

Non-routine components of HIS in Zambia consist of population-based and household surveys. Demographic and health surveys, LCMS, household surveys, and Census of Population and Housing are coordinated by the CSO in close collaboration with the Monitoring and Evaluation (M&E) department in the Ministry of Health. ZDHS is conducted every 5 years, while LCMS is conducted every 2 to 3 years. The Census of Population and Housing is conducted every 10 years. In addition, there are other surveys that are carried out for specific diseases, for example Malaria Indicator Survey (MIS) and AIDS Indicator Survey (AIS).

There is no adequate integration between HMIS and other routine health information systems and this has caused overlap in the flow of information (Ministry of Health, 2007). Typically, this issue causes poor analysis and incomplete information across health information systems, gaps in knowledge on the impact of health interventions, and duplication of efforts.

## 2.4 Health Management Information System in Zambia

HMIS in Zambia was established in 1996 by the Ministry of Health that covered almost all health facilities in 72 districts at that time. The HMIS captures data from health facilities to

help with planning and implementation activities. Overall, HMIS involves data collection, data processing, data analysis, presentation of information, and use of information (Heywood and Rohde, 2001). Currently there is a well-established data *pipeline* in order to move information from one level to another following the structure of HMIS in Zambia, as shown in Figure 2.4.

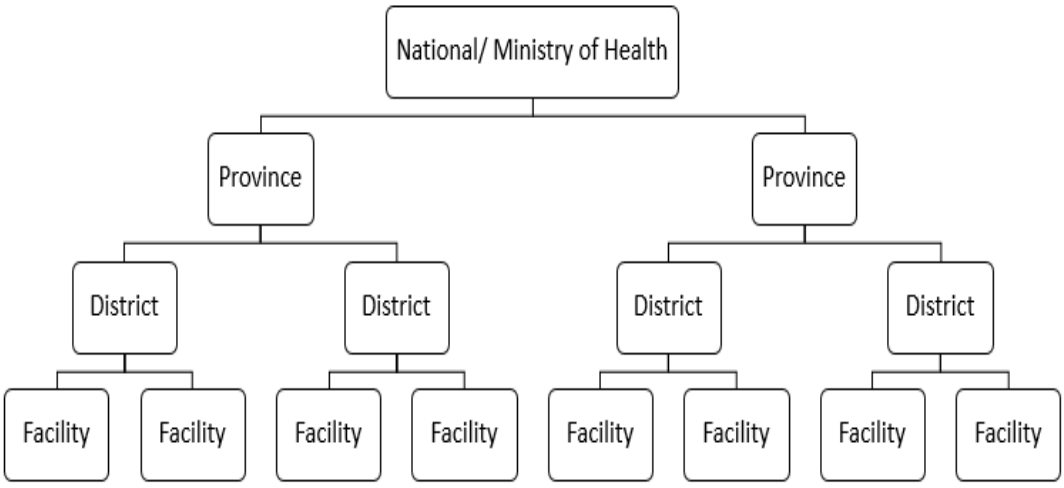


**Figure 2.4 HMIS hierarchy in Zambia**

Data collection is conducted at the facility level. Health facilities use standard data collection tools such as registers, tally sheets, and summary forms. In addition, most health facilities have community health workers (CHWs) who report to them on a monthly basis. CHW is a strategy from the Ministry of Health to improve health care delivery especially in the rural context and to deliver care associated with malaria, maternal health, and general services. Data collected then is checked for quality and sent to the District Health Information Officer (DHIO) monthly and entered to the District Health Information System 2 (DHIS2) at the district. Formally, feedback mechanism is also in place with the higher level sending feedback regularly to the lower level. However, this procedure is not consistently adhered to. There is also a system in place for annual planning and performance assessment at each level.

## 2.4.1 DHIS2

Collecting accurate and timely data has been a goal of the government of Zambia since the creation of HMIS. However, operational problems remains, which include inadequate support for training of new facility workers on reporting processes and standards, infrequent

of supervision particularly in more rural contexts and distant facilities, and insufficiency of data validation across multiple reporting forms (Chisa et al, 2015). In addition, the time for moving data from a patient encounter at a clinic to the central level can take weeks or even months (Chisa et al, 2015). In response to these challenges, the Ministry of Health began to introduce a system called DHIS2. DHIS2 is used as national health management information system for data management and analysis purposes to help with health program monitoring and evaluation. DHIS is described as *"a software application for collection, validation, analysis, and presentation of aggregate statistical data; tailored (but not limited) to integrated health information management activities"* (Braa and Sahay, 2012). It is a free and open source web-based software package, largely used for routine data capture, with a primary focus on health statistics, but also possible to be used as management system for other domains such as finance and logistics (Braa and Sahay, 2012, Sahay, Sæbø, and Braa, 2013). The development of DHIS2 is coordinated by a core team at the University of Oslo with a growing number of contributors around the world.

The history of DHIS in Zambia started in 2006 when the DHIS 1.4 was implemented. This improvement however, was followed by continuous technical and organization issues experienced throughout all levels of HMIS. At the same time, this had led to slow reporting times and poor data quality. In 2013, DHIS2 was implemented to all districts by the Ministry of Health with the support from Global Fund and PATH. In this period, the government created 33 additional districts increasing the number of 72 district to 103. During the change to DHIS2, the responsibility of HMIS-related data collection was transferred to the Ministry for Community Development and Mother and Child Health (MCDMCH) and then in 2015, the MCDMCH was discontinued and mandate for HMIS was returned to the Ministry of Health.

DHIS2 is being used to a various degree throughout all levels of health system in Zambia. It is used at the district, provincial, and national level, and non-existent at the facility level, or at least it is not operated at the facility level. The data entry to DHIS2 is done at the district offices. Currently health data is captured and processed mainly on paper at facilities. Data is then aggregated monthly and transported to the district manually. Most health facilities have computers but they are not functional for the most part because they are out of order or the staff are not adequately trained to use them. The data aggregation into DHIS2 at facility level is encouraged, to ease workload of the in-charge as it would dissolve the need to develop weekly and monthly data aggregates. In response to this, DHIS2 training for district and facility workers has been conducted since June 2017.

DHIS2 is not the emphasis of this thesis, however it was often mentioned during the field work and data collection phase. A concern was expressed about the underutilization of DHIS2 and that it is not used in its maximum function. Additionally, plenty of data is captured on DHIS2 and it could indicate the number of people using the service and with a

closer look, it could suggest the number of population accessing a facility. However, the deeper insight on this is not pursued in this thesis.

## 2.5 Health Information System Program (HISP)

This thesis is carried out under the HISP that was established by the Department of Informatics at the University of Oslo (UiO). HISP is a research and development (R&D) network in the domain of health and IT with a focus on developing countries. HISP consists of individuals and institutions such as universities, government departments and ministries, non-governmental organizations, etc. (Sahay, Sæbø, and Braa, 2013). HISP is working with a vision of developing and implementing a sustainable and integrated Health Information Systems that empower communities, healthcare workers, and decision makers to improve coverage, quality and efficiency of health services (HISP, n.d.). HISP was initiated in 1994 in South Africa and focuses on local solutions for developing country contexts and therefore subscribes to the free and open source philosophy. HISP UiO has implementing partners around the world such as HISP South Africa, HISP India, and HISP West Africa. Partners from international organizations include WHO, PEPFAR, and The Global Fund (Sahay, Sæbø, and Braa, 2013). HISP with partners, altogether are responsible for the development of DHIS2 in close collaboration with ministries of health. To date, DHIS2 is the preferred HMIS in 30 countries around the world in addition to being used at various levels in 47 countries (DHIS2, n.d.1).

The contribution of this thesis for the program builds on the research investigating challenges of population data with the context of HIS in Zambia. The thesis looks into the sources of population figures for health facility, in order to understand how they estimate catchment population. Important point of this thesis is the comparison between catchment population from different sources, in order to highlight the similarities and differences. This thesis therefore also brings out the concern that there are multiple sources of catchment population which leads to confusion and reliability issue. As a contribution to the HISP network, this thesis will inform and bring knowledge about catchment population estimation, the sources, and methods and finally this thesis will encourage more discussion on population data challenges for HIS in developing country contexts that has received less focus in research and literature.

# Chapter 3

# Relevant Literature

This chapter will describe the literature that is relevant to this research. The grand topic of this thesis is population data in health sector. Therefore, the first section will give an overview of the importance of population data which includes its role in connection with health indicators, followed by examples from different countries showing the state of population data in health sector. Furthermore, this thesis focuses on population data estimation at the facility level, often referred to as facility catchment population. Population data in general is related to the population generated from census and belongs to an administrative area. Catchment population is assigned to a health facility as a target population it serves and is often not following the boundaries of an administrative area. Assigning population figures for every health facility has been a challenge in developing countries since the availability of population data is often present only at the higher health management levels. In the second section, literature concerning catchment population will be introduced, which includes the definition and examples of previous studies of estimating catchment area and population.

The next section will describe literature concerning HIS as this is the problem area where the study has been done as part of HISP project. HIS in developing countries often includes different kinds of programs or systems which are often similar and overlapping, and struggle with weak coordination. This issue is often referred to as fragmentation. A varied number of systems and lack of coordination spawn misalignment and multiplicity of data, including population data. Population data that is studied in this thesis come from different sources which mean that multiple sources exist and each source uses their own data. A section describing fragmentation as a common problem of HIS in developing countries will be presented.

Generating reliable population data is challenging in the developing countries yet it is an essential element for HIS. Sources of information for HIS come in a variety of forms. The final section will introduce briefly census and civil registration and vital statistics (CRVS) as other common sources providing population data for a country.

# 3.1 The role and status of population data

The important role of population data is to see where there are high incidences of diseases and where there are appropriate resources available. This is done by calculating various indicators using population data as denominator. By analyzing indicators, health managers can adequately plan and deliver services, and government can direct aid and resources to parts of the health systems that need those most. Despite the increasing importance of population data for health sector, adequate data is often unavailable, as reflected in some of the developing countries such as Cameroon (Asah, Nielsen and Sæbø, 2017) and Tanzania (Olaussen, 2017).

## 3.1.1 Population data for calculation of indicators and distributing resources

This section will start by providing the definition of health indicators to form an understanding of what they are. This section will point out how population data is integral for indicators calculation and how having population data can help manager better plan resources.

### 3.1.1.1 Definition of health indicators

Indicators are ways to measure. An indicator is a way of saying *to what extent, how much*, or *how many*. In the context of public health, indicators have been defined in different ways. Indicators are quantitative measures that are useful for monitoring and evaluation of the management quality, clinical quality, management and support functions that affect patient outcomes (Silveira et al., 2015). Indicators are measures that assess a specific health care outcomes and process (Mainz, 2003). Indicators act as tools for decision-makers used as guides to monitor, evaluate, and improve the patient care quality (Mainz, 2003). Indicators should measure an aspect of quality with high clinical importance (relevance) and can be derived for geographical comparisons without substantial additional resources (comparability) (Carinci et al., 2015). There exist goals in public health, for example MDGs or goals the ministries set on their own, and we use indicators to measure progress towards the goals. Additionally, they can be used to compare performance of different places for example health centers doing similar work. Drawing from definitions above, the main purpose of having indicators is to have key statistical measures to describe the aspects that affect quality of care as a basis for professionals and organizations to evaluate what happens as relation to how well the professionals and organization perform, and finally enable them to make a decision based on what the indicators present (Mainz, 2003).

Indicators are used for different purposes (Goldsmith, 1972). Firstly, as readily understandable information, they are used by professional to inform public and the legislatures on the health situation to gain more attention for health. For operational perspective, public and legislatures would have digestible information on where to allocate more money for health. Secondly, from administrative term, indicators help managers be better planners, evaluators, and decision makers. Thirdly, in medical science context, indicators help those who are interested in performing research.

### 3.1.1.2 Type of health indicators

To cover broad purposes, health indicators can be categorized into four domains: health status, risk factors, service coverage, and health systems (WHO, 2015a). Health systems indicators relate to service delivery that include quality of care, health workforce, and health financing, for example service utilization indicator. Health status indicators relate to indicators that can describe the key health problems and guide political commitment, for example under-five mortality ratio. Risk factors indicators relate to aspects that may increase or reduce disease or health-related conditions (Burt, 2001), for example: early initiation of breastfeeding and total alcohol consumption. Service coverage indicators relate to the extent to which people in need actually receive the health interventions they need (WHO, 2009), for example, antenatal care (ANC) coverage.

Indicators are further categorized into subdomains according to the levels of the results chain framework, and are used to help with monitoring a program from when it starts to the impact it creates. These indicators are classified into four types: input or structural indicators, process and output indicators, outcome indicators, and impact indicators (Mainz, 2003, WHO, 2015a). One example is the program that organize antenatal care. Here, input or structural indicators associate with the resources needed and attributes of the settings, including availability of physicians or midwives providing obstetrical care, equipment, financial, policies, etc. Process indicators measures what is actually done and whether the planned interventions took place (Mainz, 2003), for example mothers having at least 1 ANC visit. Output indicators measure immediate results related to the activities, for example proportion of pregnant women screened for syphilis or immunized against tetanus. Outcome indicators are measures of long term results, capture the effects of care, but it takes a period of time to be seen (Mainz, 2003, Aller et al., 2015), for example antenatal care coverage or coverage of births attended by skilled health personnel. Impact indicators refer to the final expected results and they are associated with the health status of the population (Mainz, 2003), for example reduction in neonatal mortality rate and maternal mortality ratio.

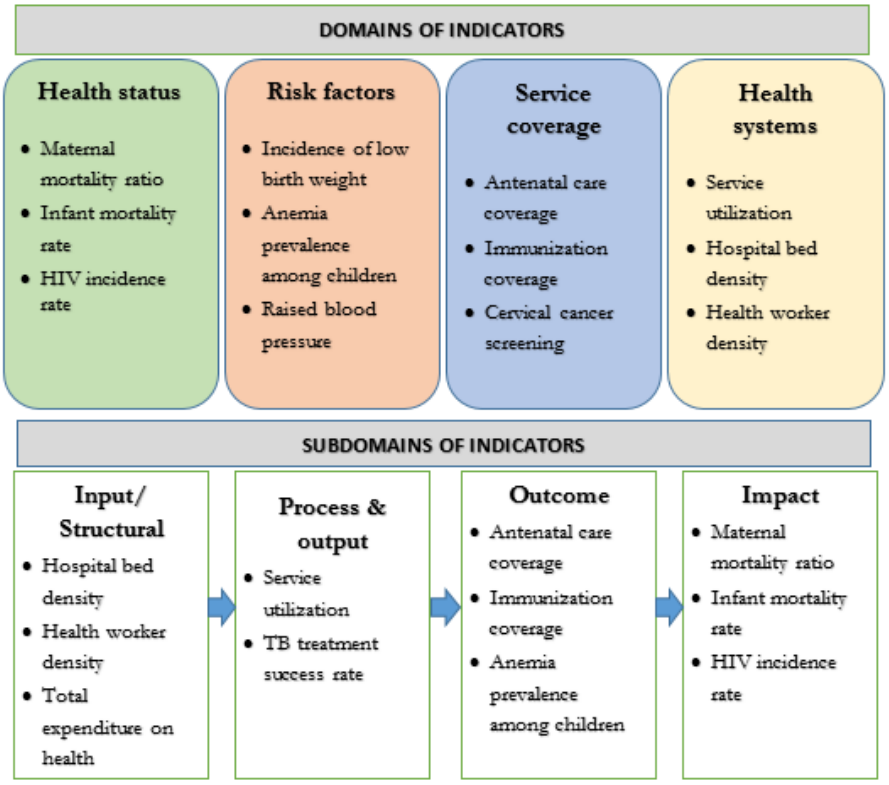


**Figure 3.1 – Classification of health indicators** (WHO, 2015)

### 3.1.1.3 The calculation of indicators

Indicators are made up of a numerator and a denominator. Numerators are the things that we count and denominators are the group with which we compare the things that we count (Heywood and Rohde 2001, Braa and Sahay 2012). Example of numerators are numbers of client, new cases of TB, and infants immunized. Example of denominators are total population and total live births in a year.

Indicators are typically expressed as a rate, a ratio, a proportion, and a count. (Heywood and Rohde, 2001). Count indicators are measures of the number of events without a denominator. Proportion indicators are typically calculated as a percentage, denote a portion or a part in its relation to the whole. The numerator is contained in the denominator. Whereas in ratio indicators, the numerator is not part of the denominator. Ratio indicators denote how much of one thing is compared to another thing, for example ratio of nurses to population. Rate indicators measures the frequency of events in a defined population (usually per 1000, 10 000, 100 000) during a specified interval. These indicators are often used to measure the probability of risk for example, infant mortality rate.

**Table 3.1 – Calculation of indicators** (Heywood and Rohde, 2001, WHO, 2015a)

| Indicator | Description | Example |
|---|---|---|
| Rate indicator | Frequency of the event in a defined time in a given population | Number of adults and children who have died due to malaria in a specific year per 100,000 population |
| Ratio indicator | Numerator is not included in denominator | Ratio of male TB deaths to female TB deaths |
| Proportion indicator | Numerator is contained in denominator | Proportion of health centers without electricity |

### 3.1.1.4 Population data as denominator in indicator calculation

Many indicators use population as denominator. Population data as denominators can be broken down by age and gender to enable specific rates to be applied. Therefore, having population data not only the total but also particular target populations such as the number of children or women is very important. Service coverage indicators for example, are the most relevant in terms of using population data as the basis for the calculation because these indicators measure the effectiveness of health program relative to its target groups (WHO, 2009). Indicators in this domain use population as denominator, for example immunization coverage among 1-year-old children. Indicator is calculated from the number of children under 1 year of age who received a specific vaccine divided by the total population of children under 1 year of age. Having this type of indicator and accurate population will help the managers to see whether a target population is covered and has access to the service. A target population that presents low coverage may indicate that health facility is not performing very well, low on resources, or is located within a very far distance. Population data becomes the basis of measurement whether the services reach the target well and equally.

Population data is also crucial for resource distribution. Being able to enumerate population data for population-based denominators is important for public health to articulate some of the most pressing disparities in the country (Purcell et al, 2016). Resources (e.g. staff, medicines, and finance) and strategies can be implemented accurately, by knowing which area that needs curative and preventive care the most and which area that needs less. The role of population data is also clear when looking at the indicators in the domain of health system as previously mentioned. Indicators in this group use population data as denominators to compare if the resources are adequate relative to the size of the population in an area. Health worker density indicator can highlight whether or not a facility

needs more nursing and midwifery professionals among others. Hospital bed density indicator can highlight which hospitals need more beds. Health service access indicator can show the total number of health facilities per 10,000 population. Having good quality indicators allows the managers to better focus on improving the health of people in the region by distributing resources to the right target.

Many population-based indicators are relevant for health management at all levels such as mortality rates, mortality ratios, and immunization coverage. Having these indicators at a district level is important to know the health status of population of a district. However, since a district contains a number of health facilities, having these indicators at facility level is very useful to know which health facilities to be the target of resource allocation or improved health intervention. This has led to the need of having an accurate facility catchment population for calculation of indicators at facility level.

**Summary**

The role of population data as denominator for various indicators is summarized in the table below. The table presents examples of indicators with their numerators and denominators, and shows that some indicators require population data disaggregated by age and sex.

**Table 3.2 – Examples of indicators using population data as denominator** (WHO, 2015a)

| Indicator | Numerator | Denominator |
|---|---|---|
| ANC coverage | Number of women aged 15-49 years with a live birth in a given time period who received ANC care 4 times or more | Total number of women aged 15-49 years with a live birth in the same period |
| ANC 1st visit coverage | Registered first ANC visits | Total expected pregnancies (number of pregnant women) |
| Vaccine specific immunization coverage under 1 year | Children under 12 months given specific vaccines (BCG, OPV, etc.) | Total number of children under 12 months |
| Full immunization coverage | Number of children 12-23 months who completed immunization | Total number of children 12-23 months |
| HIV prevalence rate (per 1000 population) | Total number of infections | Total population |

| | | |
|---|---|---|
| Service utilization | Total number of outpatient department (OPD) visits per year | Total population |
| Health service access (per 10 000 population) | Number of facilities in public & private sectors | Total population |
| Hospital bed density (per 10 000 population) | Number of hospital beds | Total population |
| Health worker density (per 1000 population) | Number of health workers by cadre | Total population |

### 3.1.2 The state of population data

Population data is required as denominator to calculate population-based indicators and thus integral for health management and yet there are cases where population data remains poor.

Poor population data is reflected in a study conducted in Tanzania focusing on LMIS (Olaussen, 2017). Population data is used as a basis for the Ministry of Health to determine the budget for procuring health commodities for health facilities and for district offices to forecast the number of commodities to order. Each facility's target population is used as a guide for the amount of financial budget allocated to each facility. The study shows that the commodities are often out of stock in facilities, indicating that the population data used is deemed to be incorrect. The last census was conducted in 2012 and there is no population data available later than that. As a result, target population estimates for 2017 may be significantly different, especially in the sparsely-populated area where people tend to move in and out to larger cities. Using outdated target population data has become an issue especially when procuring for areas with unsteady demand. The consequence of using inaccurate population data is that the budget for procurement may be incorrectly calculated and risk to overstock a facility with commodities or allocate less vaccines than needed. The funds may therefore not be used effectively. One of the participants stated that the population data seemed to be incorrect since more people are coming to get vaccinated compared to what the target population suggests. Therefore the health facilities often have shortage of vaccine supplies.

Another research was conducted in Cameroon indicating that population data is either unavailable or outdated (Asah, Nielsen, and Sæbø, 2017). Since reliable census data is not available, the National Bureau of Statistics provides the Ministry of Public Health

with population figures for each province and district annually. For administrative unit below district, population estimates are provided instead, in addition to percentage per population group, and annual projected growth rate per age group. This has left the district and facility managers calculating target population by themselves who are usually lacking needed numeracy skills to perform such calculations.

Sahay, Sundararaman, and Braa (2017) argue that population data such as from censuses and catchment population estimation make up central component of public health information system since the data are used as denominators in coverage indicators calculations. Yet a certain margin of error will always be found in the denominator data. The census in low income countries rarely produces accurate data and therefore denominator will always be in the form of estimate. Population for an area will generally be based on annual estimates of growth rate since the last census (Sahay, Sundararaman, and Braa, 2017). "*Such 'estimates of estimates' will never be accurate"* (Sahay, Sundararaman, and Braa, 2017). The census is typically undertaken many years earlier which tended to be outdated and not taking into account recent migrations (Braa and Sahay, 2012).

## 3.2 Health facility catchment population

Not only is it essential to have population data broken down by age and sex, it is also important to disaggregate the population data by geographical location to enable indicator calculation at all health management levels. National level use national population, district level use district population, and facility level use facility population.

The availability of population data at all health management levels is vital, however census usually provides population data only for areas in the country according to its administrative divisions (a country can be subdivided into provincial level, district level, etc.). There are lower administrative areas than district, such as constituencies and wards in Zambia. However, they are often not covered by the census projections.

In order to provide population data for lower levels in health system, such as facility level, there exist methods to estimate it. This section will introduce the literature surrounding catchment population as it is mainly discussed in this thesis.

### 3.2.1 Definition of catchment population

A population can be defined as a group of people with a common characteristic such as place of residence, gender, age, religion, life event such as giving birth, or use of hospital (Aschengrau and Seage, 2014). Location where people live such as neighborhood, city, or country is one of the most common ways to define a population. For example the people

who reside in district Lusaka or the country of Norway are members of different populations defined by geopolitical entities varying in size from a neighborhood to an entire nation.

In public health, populations are usually defined in association with a medical facility such as a clinic, a hospital, or a doctor's office. The population of a given medical facility is comprised of the people who would attend the facility or use the facility's services, also called the service population, effective population, and commonly referred to as catchment population (Diesfeld, 1973, Jones, Wardlaw, & Crouch., 2011, Aschengrau and Seage, 2014). Catchment population is often difficult to determine because a person's decision to use a certain facility usually depend on the distance (how far it is from home), type of medical insurance, the individual's particular medical condition, privacy, and so on (Aschengrau and Seage, 2014). Suppose there is one hospital in a district that offers a complete range of health services. The catchment population of this hospital is most likely to consist of people who live in the district where this hospital is located. Consider that this hospital enhances its department and adding new diagnostic equipment and hire well-trained staff. The catchment population of this department as a result, will expand to the surrounding districts as it grows and provides excellent care and thus people travel from further distance to access it, while the catchment population of other departments of this hospital remain to original district. Socio-economic status can also be determinant of catchment population (Aschengrau and Seage, 2014). Patients with health insurance are generally treated by public hospital and patients without health insurance are usually treated by private hospital. So these are a few of ways to illustrate catchment population of a facility.

Another term often related to catchment population is catchment area. Catchment area is the geographical area around the health facility that includes or attracts the patient population who access its services (Allan, 2014). Catchment area is a geographical area assigned to a particular facility, while catchment population is the people who live within that area. Catchment areas have proved useful in compiling health statistics. Generally, if catchment area for a given facility is known, then an estimate of its population can be produced.

In some cases, catchment area boundary of a given facility is usually imposed by the government or ministry of health to ensure appropriate health service provision to all parts of population. The natural catchment area however, may be smaller or bigger than this because in reality, catchment areas are not likely to have sharp boundaries with neighboring health facilities. Patients' preference can influence their choice of facilities they seek treatment from. People often use health services outside their catchment area and that results in poorly-defined catchment boundaries (Jones, Wardlaw, & Crouch, 2011). Overlapping catchment areas have been described by Tanser et al (2001) in terms of *inclusion* and *exclusion errors* as a measure of the degree of practicality of a catchment. Inclusion error is measured by the proportion of visitors of a facility coming from outside its catchment area.

Exclusion error is measured by the proportion of people within catchment area who seek treatment from other facilities instead.

Defining catchment area can be complicated since geographical boundaries between country administrative divisions and facility catchments are not compatible or coterminous. Unfortunately, census statistics are usually attached to such large areas and thus facility catchment areas are not neatly mapped onto the administrative boundaries. Additionally, estimating catchment population is problematic because population is dynamic (people are members of catchment population as long as they reside within the area), especially when the census projection is not updated frequently. To provide an insight about ways of how catchments are usually defined, examples in the next section will be given.

## 3.2.2 Estimating catchment population

The choice of method for calculating catchment populations often depends largely upon the amount of available information. One of the examples is from calculation undertaken in the National Health Service (NHS) of England (Gandy, 1979). The calculation is done by Regional Health Authority (RHA) so that the uniformity is maintained between various health districts and Area Health Authorities, even though different RHAs may apply different method. The source of data comes from a computer-based system Hospital Activity Analysis (HAA) providing data on patient's medical files. The data used for catchment population calculation is the number of deaths and discharges attributed to the residents of a specific district and there is also data on the number of deaths and discharges of residents treated in other district (Gandy, 1979). The distribution of deaths and discharges is applied *pro-rata* (according to/proportionate to its share of a whole) to the population district, which means no account is taken of the age-sex pattern. However, this method is used when a catchment population is already known, but it is overlapping with other clinics. So with this method, we want to know the catchment population without people who use other clinic (*residual population)*. The example is illustrated in the table below. Catchment population of District X would be 90,000-50,000= 40,000 if it is applied to the district as a whole.

**Table 3.3 - Illustration of catchment population calculation** (Gandy, 1979)

| Areas in District X | Population | Total deaths and discharges to residents | Number treated in District Y | Population attributed to District Y |
|---|---|---|---|---|
| A | 50,000 | 250 | 200 | $\frac{200}{250} \times 50{,}000 =$ 40,000 |
| B | 40,000 | 120 | 30 | 10,000 |
| **Total** | **90,000** | **370** | **230** | **50,000** |

Other literature discusses more on defining catchment areas rather than specifically estimating catchment population. Nowadays, there are various methods by geographers showing the ways in which modern geographical techniques have been applied in the medical field. Geographic Information System (GIS) methods have been used to examine the impact of distance on healthcare utilization and accessibility. GIS is also used to map catchment area surrounding the health facilities according to various methods. An example is shown in Schuurman et al. (2006), a study conducted in British Columbia's rural and remote areas, a province in Canada, to define hospital catchment areas based on travel time. The study employs a vector-based GIS network analysis to model catchments that better represent healthcare access. The first task is to build the road network dataset within ArcCatalog, a data management in ArcGIS 9.1. Secondly, travel cost attributes are created using 1 hour travel-time along the road network, depending on speed limit and travel impactors (stop signs). Finally, the study uses Census Block for population data sources which provides finer spatial resolution in smaller areas. This enables estimation of total population residing within one hour travel-time catchment.

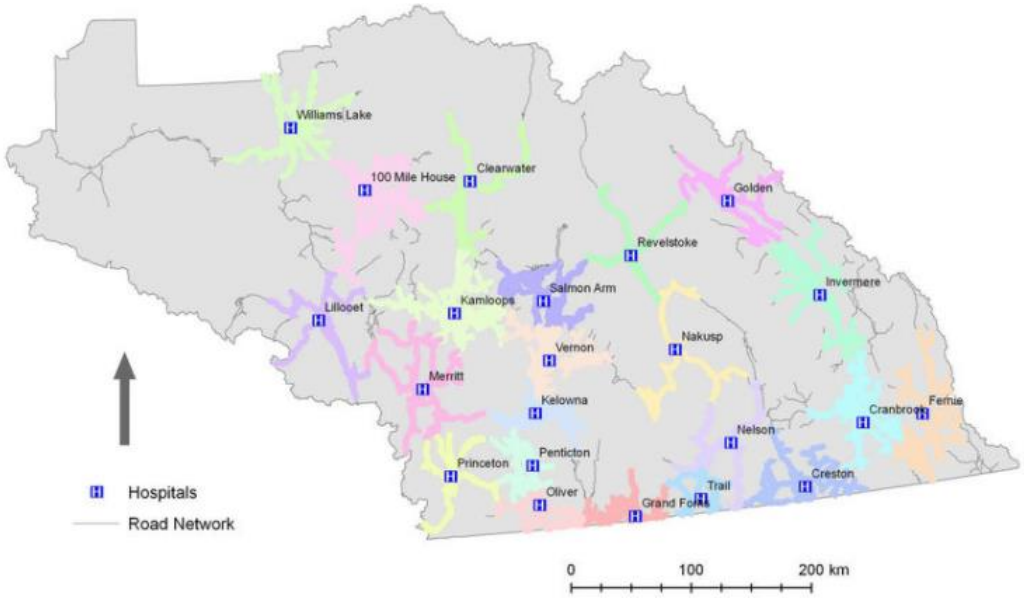


**Figure 3.2 - One-hour catchment areas for all hospitals** (Schuurman et al., 2006)

Different research was conducted by Zinszer et al. (2014) on determining facility catchment areas in Uganda using various methods. Their study also involves GIS (using ArcGIS 10), and obtains mapping files from Uganda Bureau of Statistics, provided with the geographical coordinates of all parishes. Parish is the second smallest administrative area in Uganda. Which parishes included in the catchment area of a facility will be determined by 3 parameters: a) the straight-line distance from a facility, b) the road network distance, and

c) cumulative case ratio for malaria-related visits. 5, 10, 20, and 30 kilometers length are used for distances and radius. The cumulative case ratio is defined as "*the ratio of the **observed** to the **expected** number of malaria-related visits to a facility"* (Zinszer et al., 2014). A parish was included in the catchment area if the study showed that it contributed notably higher malaria-related visits than expected for its population (Zinszer et al., 2014). This approach was based on *patient-flow method* which uses proportion of patients accessing health facility coming from a particular administrative area: if the proportion is greater than a set minimum, that administrative area is included in the catchment (Zinszer et al., 2014).

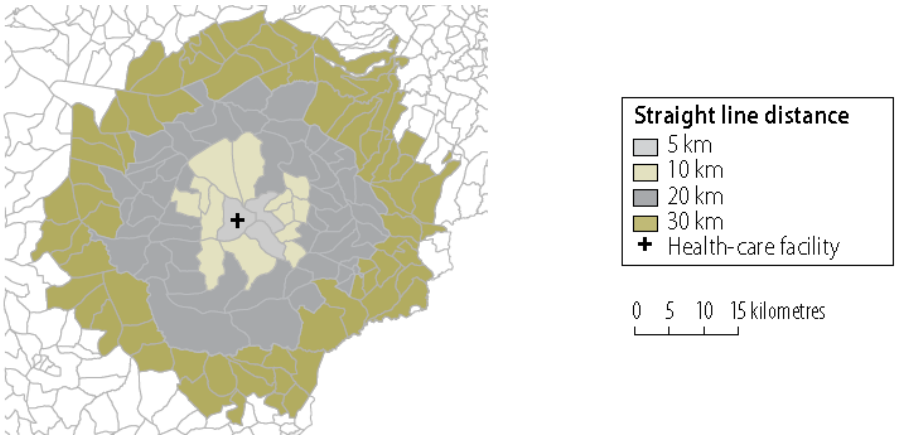


**Figure 3.3 – Result of defining catchment area based on straight-line distance**
(Zinszer et al., 2014)

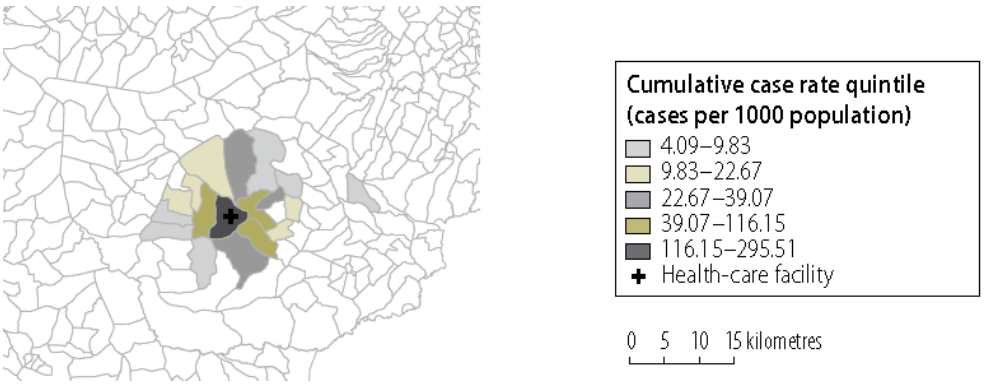


**Figure 3.4 – Result of defining catchment area based on malaria-related visits**
(Zinszer et al., 2014)

The availability of real world data has been identified as a significant factor of the GIS modelling (Allan, 2014). Population data of each parish should be available in order to estimate the catchment population within. Cumulative case ratio catchments take into

account where patients actually live, since their addresses are recorded during the visit. This shows us where more patients actually come from. Defining catchment area based on the distance has the advantage of simplicity. Even though distance is important, it is not the only factor influencing choice of a patient.

The literature above illustrates the challenges of estimating catchment population.

- Calculating catchment population relies heavily on the amount of available information. Data used as a basis for calculation can be data routinely recorded at a health facility and then used as a proxy, census data, or maps from GIS.
- Different health authorities may use different methods. Generally there is no unified method used for calculating catchment population. If the same data used as the basis for calculation is not available in other areas, then different method would be preferred.
- Different techniques used to estimate catchment area render different result.
- Even if catchment areas can be drawn or estimated, filling the area with the correct population is difficult when there is no reliable population data down to the lowest administrative level or data of where residences are located.

# 3.3 Understanding Health Information System

## 3.3.1 Health Information System

Sauerborn and Lippeveld (2000) defined HIS as *"a set of components and procedures organized with the objective of generating information which will improve health care management decisions at all levels of the health system".* Similar interpretation of HIS was described by Lwanga, Tye, and Ayeni (1999) as *"the mechanisms and procedures for acquiring and analyzing data, and providing information (for example, management information, health statistics, health literature) for the management of a health program or system, and for monitoring health activities".* From this definition, it can be concluded that the purpose of HIS is to provide information to improve action. In practice, in the health sector there are different information systems with different functions. HMIS is dealing with the aggregation of data concerning day-to-day provision of services, and Electronic Medical Records is dealing patient level data in the hospitals (Braa and Sahay, 2012). There are other information systems dealing with a variety of functions such as logistics and drugs, typically referred to as LMIS, and others are dealing with finance and human resources. These different information systems in the health sector are therefore referred to as subsystems of HIS.

**Table 3.4 – HIS and use of population data**

| Health Information Systems | Use of Population Data |
|---|---|
| HMIS | Estimating catchment population (total population, total children under 5 years old)<br>Denominator for indicator calculation (e.g. immunization coverage indicator) |
| LMIS | Forecasting order of vaccine |
| HRMS (Human Resource Management System) | Denominator for indicator calculation (e.g. number of nurses per 1000 population) |

The diversity and multiplicity of health information systems causes emergence of the need to integrate information coming from each of them. Ideally, all these subsystems of HIS should be able to communicate with each other, share information, and produce a more integrated information for health managers to take more effective decisions (Braa and Sahay, 2012). The effort for moving towards an integrated HIS is still a major challenge in developing countries.

All the health information systems will require data sources to generate information. There is "*no single data source that can provide all of the information required for planning and management of health services"* (Lippeveld, 2000). National HIS will always need a combination of data collection methods. Depending on the nature of data collection method, HIS can be classified into two categories: routine health information systems and non-routine health information systems (Lippeveld, 2000). HMIS is an example of a routine health information system. The data collected is based on patient encounters in the health facilities. The focus of routine HIS has been geared towards health care provision to individuals and therefore generates health information of those individuals who use the regular health services. Non-routine health information systems include surveys (e.g. demographic and health surveys) (Lippeveld, 2000).

*"The health information system is part of the health system and wider statistical system"* (AbouZahr and Bourma, 2005). The Ministry of Health has the main role of generating health data and being a primary user of data for public health action. In spite of this, the accountability of health-related statistics is often dispersed across different line ministries and agencies, such as ministries of housing, education, and employment. National statistics offices are often involved in generating health-related statistics that can be done through censuses and surveys. The degree to which there are good working links between Ministry of Health and other line ministries and agencies, differs in countries (AbouZahr and Bourma, 2005). This indicates that even though HIS is overall managed by the Ministry

of Health, HIS involves different part of institutions and stakeholders in the country and it cannot function effectively without the participation and coordination from various parties.

## 3.3.2 Challenges of HIS in developing countries

Health information system in developing countries adhere to the principles of HIS in general except with challenges such as poor institutions, extreme shortages of health workers and resources, lacking infrastructure, (Kirigia and Barry, 2008) and numerous amount of international organizations such as donors. There exist corruption, and poor leadership and management which result in inadequate health-related legislation and strategies, low financial investment in health, and weak inter-sectoral action (Kirigia and Barry, 2008). The environment in which HIS operates are often not provided with trained staff who are able to maintain and run a HIS. In the context of this research, the most relevant infrastructure challenges are associated with unstable electricity and inadequate Internet connections. Provision of computers and mobile equipment are often supported by outside actors in the beginning, with the objective of eventually become self-sustainable. Local capacity building is important and a way to address the lack of skilled worker yet trainings are not regularly conducted. Although the presence of international agencies is highly needed, this often creates situation where the Ministry of Health put more focus on attending workshops and responding to donor inquiries and less on providing service to households (Kaseje, 2006).

Apart from mentioned challenges, Braa and Sahay (2012) elaborate that HIS in developing countries is often characterized by fragmentation. This section will therefore provide overview of some of the common challenges particularly with fragmentation related to population data.

### 3.3.2.1 Fragmentation of HIS and population data

Health information system in developing countries is usually fragmented (Braa and Sahay, 2012). Fragmentation in HIS is a phenomenon where "…*various vertical programs exist and each collecting their individual information independent from other programs with little regard to supporting the overall HIS"* (Braa and Sahay, 2012). The number of actors working in information and global health development has increased, and various private donors contribute more to reaching global health goals by providing much needed financial support to countries with limited resources, and establishing their own specific systems (Braa and Sahay, 2012). In developing countries, there is a series of different donors with their respective programs (Braa and Sahay, 2012). These new dedicated players have provided a lot of benefits, however their individually separated systems have fragmented the universe of health data (UN Foundations, 2011, Adwok, Kearns, & Nyary 2013). Vertical programs are typically funded by donors and when the donors fund a country and

request for disease-specific indicators report such as Tuberculosis, HIV, or Malaria, the country will typically create a vertical program to comply (UN Foundations, 2011). Whenever a new health program created, it is often that existing programs are not taken into account. Factor such as whether required data is already collected in another program or reporting system is often neglected (Braa and Sahay, 2012).

Vertical programs are typically organized differently, in terms of which data elements are collected, to whom data is reported and how often data is reported, etc. (Chilundo and Aanestad, 2004). As a consequence, this places high workload on the health personnel who collect data and causes unnecessary duplication of efforts and a waste of financial resources that could be better directed elsewhere.

Furthermore, HIS involves different domains or sectors in the country. Information for HIS come in a variety of sources, including other line ministries apart from Ministry of Health, and national statistics offices. Each ministry and national statistical office have their own program and policy on how to conduct their work. The issue arises when there is no strong inter-sectoral link between the Ministry of Health and these institutions, making HIS fragmented as there is no adequate strategies on how to exchange information between their systems.

In addition to excessive data with big overlaps of the same data collected multiple times, data and indicators are poorly standardized making the comparisons across programs difficult. Some programs have strong and collect a lot of quality of data whereas the other programs are the opposite (Braa and Sahay, 2012). Ministries of Health from developing countries have voiced their concerned regarding fragmentation and expressed their need of information that is available horizontally across different programs. For example, the Ministry of Health in Zanzibar expressed that getting an overview of the situation across different diseases and services areas is challenging by having to ask for information from various program offices and *"…the resulting information is not easy to comprehend, compile and analyze, as each office tends to structure their information differently..."* (Braa and Sahay, 2012).

Fragmentation has affected how population data is managed in HIS.

- Firstly, the issue is concerning the weak state in inter-sectoral coordination. National statistics offices are generally responsible for census and household surveys and therefore supply health-related statistic data including population data for administrative units which the ministry of health or health managers can use. However, weak link between organizations exists and prevents them from being able to perform in sync and exchange information in a timely manner. Updates of population data from national statistics office may not be available for health managers when needed, and in consequence health managers are forced to enumerate their own (catchment) population based on census data that may be considerably different from the actual population.

- Secondly, vertical programs often do their own calculation of population estimates. Many vertical programs have their own arrangement of information stream (data collection, analyze, reporting, surveys) and they often apply their own method for estimating population data on their data analysis - for example indicator calculation – especially when population data from HMIS is not available or provides great uncertainty.
- The major issue with fragmentation here is that there is no standardization for source of population data or catchment population. As a result, district offices, health managers, and vertical programs may apply their own method and use their own population estimates, making population data fragmented. In addition, this makes it difficult to do analysis and cross comparison. For example, same coverage indicator presented by HMIS and a vertical program may result in overly different number since they use different population figure for denominator. As a consequence, the reliability of presented indicators is in question and this impacts the manager's decision-making.

## 3.4 Population-based information sources for HIS

Data for health information system are usually generated from two kinds of sources. One is directly from ***populations***, and second is from the operations of health and other ***institutions*** (Health Metrics Network, 2008). Population-based sources produce data on all individuals that can include total population counts (such as census and civil registration) and data on sample populations (such as household surveys). Institution-based sources generate data as a result of operational activities (such as records at a clinic). This section briefly introduce the two important sources (census and civil registration) that can be used to provide data on the size of a population, its distribution, demographic and statistics. In many developing countries, the state of these two sources is relatively poor and thus population data generated is often unreliable.

### 3.4.1 Census and challenges in census taking

Census is defined by the United Nations as "*the total process of collecting, compiling, evaluating, analyzing and publishing or otherwise disseminating demographic, economic and social data pertaining, at a specified time, to all persons in a country or in a well delimited part of a country"* (Ezeah, Iyanda and Nwangwu, 2013). The population and housing census is the main information source for providing the size of a population and its geographical distribution as well as demographic, social, and economic characteristics of its people (Health Metrics Network, 2008)**.** Ideally, census should be conducted every 10 years and should provide statistical data on population and housing to the smallest administrative levels. Population census enumerations generally provide data for the census year which are

usually available two to three years after the census taking. Census does not offer population data on a continuous basis as estimates generated for 10 years forward is a result of projection. Projections may be adequate for national level, but in local level estimates are often not accurate because of dynamic changes from migration or urbanization. In terms of health sector, information on population figures and its characteristics by age, sex, etc. is essential for local and national planning, estimating target population size and trends, assessing service coverage rates, etc. (Health Metrics Network, 2008)**.** Although census is one of the most important things a country must undertake, in many developing countries a lot of challenges exist making it difficult to conduct the regular census.

**Challenges**

a) The cost of conducting census

   The cost of census taking varies from country to country but typically it is quite expensive and can be overwhelming even for developed countries. For low and lower middle income countries, having limited sources can be difficult for allocating vast amount of money for census taking. Problems in giving wages for the enumerators also exist. Some countries pay the enumerators an average wage and others pay only honorarium, and some pay nothing (Bair and Torrey, 1985). The growth of population also increase the potential costs of counting and additional people (Bair and Torrey, 1985). As a result, many poor countries struggle to conduct census as regularly and as efficiently as developed countries do.

b) Insufficient of skilled personnel

   Often, the governments do not have experienced census officers and demographer experts and would end up using inexperienced officers to conduct the job. It is often that surveyors are volunteers that have little knowledge on conducting census taking. Lack of experts in this field may provide inaccurate population estimations (Okolo, 1999).

c) Inadequate infrastructure facilities and poor demographic maps

   In certain areas, the condition of infrastructure such as roads is poor and inaccessible. Many surveyors cannot reach remote areas without sufficient roads that connect various villages. Additionally, if the demographic maps are not reliable, some of the extremely remote villages will not be visited. As a result of these challenges, some areas will end up not being counted by the census.

## 3.4.2 Civil Registration and Vital Statistics (CRVS)

CRVS as defined by the United Nations is the "*universal, continuous, permanent and compulsory recording of vital events provided through decree or regulation in accordance with the legal requirements of each country*" (The World Bank Group, 2014). Unlike other

sources of population such as census and household survey, CRVS provides population dynamics on a continuous basis. Therefore it can provide more accurate information and the denominator for evaluating progress, and facts essentials to government for planning. Unfortunately in some countries, especially underdeveloped countries, many people are born and die without leaving a trace in any legal record because their civil registration systems that log vital statistics have not developed over the years (Setel et al., 2007). To health sector, well-functioning CRVS is important as many MDG indicators rely on accurate data for births, deaths, and causes of death (Setel et al., 2007).

As an example, Norway has developed one of the most advanced CRVS systems in the world, organizing vital events of its people such as births, marriages, deaths, and migration (Statistics Norway, 2014). Personal identification number (PIN) is issued immediately by the tax authorities after receiving notification of birth from hospital (Statistics Norway, 2014). The PIN is permanent and all relevant information is kept in Central Population Register (CPR) and updated regularly. In other contexts, particularly developing countries, CRVS is weak or non-existent, and thus cannot serve as the source of vital statistics (Health Metrics Network, 2008). CRVS is in such poor state because there is weak administrative capacity and lack of political priority which result in poorly managed and underfunded CRVS system (United Nations, 2012, The World Bank Group, 2014). Registration offices are also often not accessible and sufficiently equipped to most of the rural community. As a result, a number of births and deaths may not be registered.

## 3.5 Summary

This section provides summary of the challenges to population data.

**Calculating catchment population is a challenging task.**

- There is no reliable population data at the lowest administrative unit which could have been useful for health authorities to estimate the population living surrounding the facilities.
- Using service data as proxy to estimate how many people a facility serves is often difficult since the same service data may not be available in all health facilities. This means estimating catchment population depends highly on the available information.
- Determining catchment areas is often difficult because it is not mapped neatly onto the administrative areas. Assigning population to a catchment area becomes problematic as the boundaries between catchment area and administrative area are often overlapping.

**Fragmentation in HIS and population data**

- Vertical programs may use different method to estimate catchment population making multiple sources of catchment population data exist.
- Population data may not be available in the same systems as the health service data. Population data often exist in the systems of national statistical office and while health service data exist in systems for HMIS or in the Ministry of Health.

**Census and CRVS**

- Conducting census is very costly in terms of manpower, finance, and time, therefore it may not be possible to undertake census frequently.
- CRVS is in poor state making births and deaths go unregistered.

# Chapter 4

# Methodology

The purpose of this chapter is to present the research methodology as well as the empirical techniques applied. The first section will introduce the approach used in this thesis which is a combination of qualitative and quantitative study. It also introduces the philosophical assumptions underpinning the research which come from interpretive tradition. The research strategy will be introduced in the second section. The strategy adopted was a single case study with the case being Zambian health sector. Under this case study, the fieldwork was conducted at the site during the period from October 2016 to November 2016 and correspondence was also maintained after the field work has finished. The next section will present techniques for data collection and analysis. Finally, some notes on reflections from doing this study will be provided.

## 4.1 Research methodology

There are various ways to classify research approach with the most common being qualitative research and quantitative research (Myers, living version). According to Creswell (2013), qualitative research allows the researcher to collect *"open ended emerging data with the primary intent of developing themes from the data"*. Qualitative research is common among Information Systems (IS) studies by gathering qualitative data using interviews, document analysis, and participant observation, to understand and explain social phenomena (Myers, living version).

On the other hand, Golafshani (2003) argues that quantitative research is any kind of research that produces findings "*…by means of statistical procedures or other means of quantification"*.

This thesis uses a combination of both qualitative and quantitative data. One of the aims in this study is to understand the methods used by different actors in HIS in Zambia for estimating catchment population. Qualitative research methods are appropriate for such an aim, for example through interviews and discussions with informants. This is supported by Gill et al. (2008) who suggested that qualitative methods such as interviews are believed to provide deeper insights of social phenomena than would be obtained by purely quantitative methods such as questionnaires. Myers (living version) argued that the essence in understanding phenomena from participants' point of view and its particular social and

institutional context, is largely lost when the data are quantified. Therefore understanding the informants' experiences in working with population data and its issues would be very difficult if the data is represented in numbers.

Since this study is also working with numerical data, it has a large element of quantitative research too. The quantitative side of this study is exemplified by the technique used to analyze the quantitative data such as population figures. Population figures will be compared and analyzed statistically. This study therefore presents findings that are numeric in form, arrived by means of statistical analysis.

The advantage of using both qualitative and quantitative data is to provide a more complete understanding of the research problem and to obtain information on phenomena that are difficult to obtain by either only qualitative or quantitative approach. These data complement each other. For example, this thesis presents the methods used for calculating catchment population, and furthermore, comparison between catchment population figures provides additional insight and complementary views. This mixed methods research approach can be used to reveal the "whole story".

This thesis can be categorized as an interpretive study and therefore finds itself within interpretive paradigm. Interpretive paradigm assumes that the world or reality appears only through social constructions such as language, consciousness, and shared meanings (Myers, living version). This study subscribes to assumptions that knowledge is subjective and the ways of discovering it are also subjective (Scotland, 2012). Such social constructions and subjectivity have shaped how this study was conducted by aiming *"…at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context"* (Walsham, 1993). Phenomena must be understood in the social contexts in which they are constructed, and thus there are no predefined dependent and independent variables but rather a focus on the complexity of human sense-making as the situation emerges.

The research will be affected by the different explanations coming from the informants as well as my own interpretation of their perception of how the population data is managed. Therefore, the truth this study looks for is not given but rather formed and gathered from subjective meanings and information from participants in the field. The interpretive stance was also applied when looking at the comparison of population figures in this research. Even though the data is numerical and the analysis is objective, the more important focus here is to interpret what the numbers mean.

A positivist paradigm is not preferable for this kind of study as it is used when a theory is being tested (Myers and Avison, 1997). This study however, does not focus on hypothesis testing but rather in the depth of the phenomena.

## 4.2 Case study

The methodological framework for this research has been of interpretive case study. This is opposed to positivist case study that involves empirical testing or proving of a theory (Shanks, 2002). Case study as research strategy used in this thesis is rather exploratory and the purpose is to provide an intensive description and analysis of a single bounded unit within a specific context to provide insight into a real life situation (Merriam, 2009, Pickard, 2013). Using case study methodology has several strengths that include the ability to use variety of research methods and the ability to obtain rich description that can be applied to similar situations (Merriam, 2009). The important feature of case study is its focus on answering "how" and "why" questions (Myers, 2009) and for this reason is well suited for descriptive and exploratory research.

According to Benbasat, Goldstein, and Mead (1987) the following questions can help to determine if case study approach is appropriate for a particular situation:

a) Can the phenomenon of the interest be studied outside its natural setting?
b) Must the research focus on contemporary events?
c) Is control or manipulation of subjects or events necessary or possible?
d) Does the phenomenon of interest enjoy an established theoretical base?

Investigating how population data in Zambian HIS is estimated requires the research to be conducted in its natural setting. The case and subjects must be studied as they are. The research focuses on contemporary events such as activities or estimation methods that are relevant at the present time. The control or manipulation of subjects, in this instance the DHIO or Akros managers, and the environment, is not possible. This is because the focus is to understand the real life situation. The theoretical base on the phenomenon under investigation is limited. Case study approach supports the relevance of my thesis since investigating and analyzing a phenomenon is considered more persuasive to research participants (actors in Zambian HIS and Akros) than theoretical discussions. The case study methodology is therefore suitable for my research.

Case study that is rich with qualitative component can be used as a basis to recommend actions and inform policy, a contribution a research in HIS in developing countries often seeks to make. Insights from this research will hopefully provide useful inputs for stakeholders in Zambian health sector as well as researchers and implementers for improving population data estimation for health sector in developing countries.

### 4.2.1 Selection of the case

A case is a *"detailed examination of a single example"* (Flyvbjerg, 2006) and a *"specific, unique closed system"* (Stake, 2005). The research problem is to investigate population data

estimation in health sector in the developing countries, and Zambian health sector was selected to be the case study. Zambian health sector is also the guiding scope, however in reality, it is a broad topic and is difficult to be characterized as a one closed system. Myers and Avison (2002) suggested that the boundaries between phenomenon and the context in case study are not clear. For example, when looking into population data in health sector, the units of analysis could include entities outside Zambian health sector, such as Central Statistical Office who operates in different sector, but nevertheless offers significant relevance towards the case. This is also why case study is appropriate for this particular research because it focuses on trying to understand the case with its complexities (Stake, 2005).

The case used in this research was not explicitly chosen, but rather occurred as an opportunity as it was dependent on the possibility of access. The principle in determining appropriate cases is the preference for cases that can offer rich information with respect to the problem under investigation (Patton, 2002). Contacts in industry, academia, and personal networks can be helpful to form a list from which cases can be selected. Since this research falls under HISP at the University of Oslo, there were several partner countries that could be the potential cases in the beginning. Zambia was chosen because there was positive feedback from Akros as the partner of HISP based in Lusaka, who offered help facilitating the research. Zambia is one of the developing countries who is struggling with producing quality population data for health sector, and for this reason, it is an appropriate case to better highlight the challenges of the topic.

### 4.2.2 Instrumental and intrinsic case study

Stake (2005) has helpfully categorized three main types of case study: intrinsic, instrumental, and collective. An intrinsic case study is conducted to learn about a unique phenomenon. The researcher wishes to understand this particular case better. The uniqueness of the case should be defined which distinguishes from all other cases (Crowe et al., 2011). An instrumental case study is undertaken when the researcher wishes to examine a particular case to provide insight into a phenomenon. When the researcher wishes to examine a number of cases jointly, then the case study is characterized as collective case study. It is an instrumental case study extended to several cases (Stake, 2005).

This research is characterized as an instrumental case study. The phenomenon under investigation is the estimation of population data in health sector in developing countries. Using Zambian health sector as a single case, the case study produced insights into that phenomenon. It is instrumental because the study can contribute to knowledge on this particular topic and therefore can inform other cases that have similar contexts. In other words, Zambian health sector was used as a tool to highlight the issues on population data

topic. However, this study also contains characteristics of an intrinsic case study. If this particular study is conducted in another developing country, the result and process might turn out differently. This satisfies the feature of an intrinsic case study where the case is unique, distinguishable, and thus cannot be applied to other cases. Therefore perhaps this case study is the combination of both.

The summary of case study design for this research can be found in table below.

**Table 4.1 - Case study investigating population data in the Zambian health sector**

| Case study design | |
|---|---|
| Context | Developing countries are struggling to produce reliable population data for health sector. Population data is also not available below district level and this forces the district health offices to do their own estimation for facility level. This study aimed to provide insights into the challenges of population data estimation by looking at the methods used for calculation, and comparison between population figures from different sources. |
| Objective | To investigate methods for population data estimation and compare the population figures from different methods and sources. |
| Study design | Single instrumental & intrinsic case study |
| The case | Centered on the population data estimation in Zambian health sector |
| Data collection | Semi structured interviews, meetings, e-mail discussions, document analysis |
| Analysis | Qualitative: reading, coding, and comparison progressed iteratively<br>Quantitative: statistical analysis (finding percentage difference) |

# 4.3 Conducting case study

Case study was chosen as the overarching research methodology under which the field work was conducted in Zambia. This section will inform activities prior to the field work and during the field work.

## 4.3.1 Prior to field work

It was decided that it would be a great idea to have a field trip as some hands on experience looking into HIS in a country, preferably somewhere in Africa. Before deciding on going to Zambia there was a lot of back and forth about different projects that I could potentially participate in for my thesis. Zambia quickly became the target as there had been an ongoing project conducted by an HISP team. The exact topic for the thesis had not been decided yet

at the beginning but there existed some ideas on what things could be studied. Planning the field trip to Zambia was not simple however. The trip had to be postponed due to cancellation of that project. It was decided that we needed to pursue another opportunity so that the trip could be made.

After some time, a contact with Akros, an NGO in Lusaka was established and positive feedback was received. Few weeks before the trip, there had been discussion about what the thesis should focus on. Akros suggested that the topic should contribute to them and it would be more meaningful to look into an urgent issue. They pointed out that there were existing issues about population data in Zambian health sector and therefore it was decided to be a good opportunity to look into it.

Gathering necessary background information prior to the field work and data collection process is important as suggested by Darke et al. (1998), to gain better understanding of the empirical setting. Background and overview of Zambian health sector were largely collected and prepared before the field trip from documents that are available publicly on Internet. Benbasat, Goldstein, & Mead (1987) suggested that interview questions should be provided prior to the visit. Since the topic was decided quite soon before the trip, there was not adequate time to formulate the exact questions. Formulation of good questions can be challenging especially when the topic is not understood fully and research questions have not been decided. Deeper understanding of the topic was gained after meeting with Akros staff.

### 4.3.2 Field work

The field work was carried out for the periods of 4 weeks where the primary data collection took place, from mid-October through November 2016. The first week of visit was used for making a thesis draft with additional supervision from an Akros manager. The purpose is to have a focus in the study. A quick sit-down with this manager revealed that the population data at the facility level is not reliable since the census does not provide numbers for areas smaller than districts. At the same time, Akros was informed that an NGO named PATH has also made estimation for health facility catchment population. Therefore, comparing facility catchment population from these 2 sources seemed to be obvious idea. Furthermore, this topic has received little focus as well from Akros or research in general.

The rest of the time was used to conduct the data collection and at the same time read literature. While in Lusaka, I was provided a place to work at the Akros office. I had close contact with the HMIS team from Akros, participated in meetings and discussions. Working with this team has allowed me to get better overview of HMIS in Zambia. After some discussion, relevant informants were identified and through help from Akros, the contact could be made. After coming back to Oslo, correspondence was still maintained. However,

there are limitations during this field work which will be elaborated in the last section of the chapter.

# 4.4 Data collection

The first goal of data collection is to understand how Zambian health sector functions in general, including how the census works. The second goal is to find out the methods used for estimating facility catchment population from 2 sources, PATH and District Health Office. The third goal is to obtain population figures for comparison between these sources as well. A number of data collection techniques were used to achieve these goals.

## 4.4.1 Interviews

Primary method for data collection in this thesis is interviews performed during the field work. Three fundamental types of interviews are structured, semi-structured, and unstructured (Gill, Stewart, & Chadwick, 2008). Depending on what the researcher is trying to answer, the type of interview used can be different. In order to get better understanding, interpersonal skills such as questioning, listening, and conversing are deemed necessary. For this reason, semi-structured and unstructured interviews were employed since these methods provide more flexibility. The benefit of semi-structured interviews is it can be used to obtain as much information from the interviewee as possible because it gives room to the researcher to deviate from the pre-planned questions and thus follow up the informants based on their answer (Jamshed, 2014). Unstructured interviews are performed with little to no organization and do not reflect any preconceived ideas (Gill, Stewart, & Chadwick, 2008). This allows respondent to answer an open question.

**Key informants**

During the visit, the impression I had gotten was that there was a small number of people that had knowledge around population data. This has shaped how the informants were chosen. Key informants interviews involve interviewing a select group of individuals who are likely to provide needed information on a particular subject and have firsthand knowledge on the subject. Notes were taken during each interview and then written up as soon after the interview as possible on the same day. Informants in this study include:

**Table 4.2 - List of interviews**

| Source | Number | Informant | Type of interview | Subject |
|---|---|---|---|---|
| District Health Office | 1 | DHIO | Semi-structured | Methods of estimation<br>Challenges of population data |
| | 1 | District Manager | | |
| PATH | 2 | Analyst | Semi-structured | Methods of estimation<br>Challenges of population data |
| Akros | 1 | HMIS Manager | Unstructured | General knowledge on population data<br>Differences in comparison |
| | 1 | HMIS staff | | |

The interview with informants from District Health Office was done at the same time which means both were present. This is the same with PATH. Getting an interview with district health officers was difficult because the permission was not approved. This interview could happen because the opportunity was obtained using a strategy of personal networks and word-of-mouth referrals. The informants did not want the interview to be recorded. As a result notes were taken throughout the interview. Interview with PATH was obtained without difficulty and was conducted by Skype since the analysts were based in Seattle, the United States. Questions for both interviews are similar because the purpose is to obtain population data estimation method from each of them and also to learn their experiences.

Unstructured interview resembles conversation more than interview. However, it is still controlled somehow as the conversation was skewed towards the researcher's interests. This interview was done occasionally when the manager has time and is at the office. Due to work in other cities, the availability of this interviewee had been sporadic. The benefit of using this method is that it can be used when the problem in question is virtually not known. Not much was learned before the field work started so general questions on population data were asked in this interview with the manager. Such an interview can simply start with a question *Can you tell me about your experience with looking into population data for health facility?* Furthermore, this method is appropriate when different perspective of an issue is required. Such interview question asked is for example *what do you think about the big difference between these population figures?* Akros has extensive experience with helping Zambian health sector improve its health information systems, therefore these interviews could provide additional views or insights on the subjects that were discussed with the other informants, from PATH and District.

### 4.4.2 Meetings and discussions

In the first week of the field work, HMIS team at Akros held a meeting in order to present their project and introduce me their daily routines. It was decided that I could participate in their meetings so I had the opportunity to obtain as much general background as I could to understand how HMIS functions in Zambian health sector. The meetings were held weekly every Friday morning. The meetings were necessary to supply me with important insight on the present situation. The subjects of the meetings were not always relevant with my thesis topic, but it was still useful to give insights on other issues such as poor infrastructure, poor communication, problem with reporting and accountability. It was revealed that population data was not discussed extensively at Akros and therefore conducting the thesis and interviews could help them highlight the issues and become a useful input for them.

During the meetings, notes were taken on every subject presented by each member of HMIS team. Even though some were not relevant, I felt it was necessary for me to still participate and give an opinion if any. This meeting had become valuable opportunity to present my findings or ask for opinions from HMIS team. During this meeting also, the HMIS team could suggest or refer me to informants that I needed to speak with.

### 4.4.3 E-mail discussions

In the first week, an Akros manager introduced me to some people who have looked into population data in the past. This started the e-mail conversation among researchers and Akros partners. Some data can be extracted from unstructured e-mail discussion. For example when asked about the current situation in regards to population data, it was revealed that there has not been substantial work conducted to look into it in Zambian health sector. Some work in the past demonstrated that the health facility list did not match with Akros' list or other NGO's list which is similar issues demonstrated in my findings. An impression I had gotten from this discussion is that some people had ideas on how to estimate population data better but population data has unfortunately not been the top priority when improving HMIS. E-mail discussion was useful to get views on current situation and impressions from people who have previously looked into the topic.

### 4.4.4 Document analysis

As suggested by Bowen (2009), documents are important sources of data for interpretive studies. The forms of documents may vary from manual, background papers, brochures, to journals, program proposals, and organizational reports.

Reading of documents commenced before the field work to gain understanding of the areas of population data in health sector including its importance and previous research done around this topic. Sources of documents came from various journals and international organizations. In addition, in order to gain a better understanding of the context of the thesis, it is important to read documents about HIS in Zambia in general. Another important document is Population and Demographic Projections 2011-2035 released by CSO as a product from the census. This document is important to highlight findings and for analysis.

Below is the table listing documents important for understanding HIS in Zambia including release year and a short description.

**Table 4.3 - Document analysis**

| Actors | Document name | Year | Description |
|---|---|---|---|
| Akros | Zambia HMIS Assesment Draft | 2016 | Situational assessment of health facilities performance and recommendations |
| Ministry of Health | National Health Strategic Plan 2011-2015 | 2011 | Includes the description of health status and health sector organization in Zambia |
| CSO | Population and Demographic Projections 2011-2035 | 2013 | Contains population figures for all administrative areas in Zambia after the census that took place in 2010 |

### 4.4.5 Obtaining population figures

For comparison purposes, it was important to obtain population figures at the facility level as well as district. Population and Demographic Projections document provides population figures for all administrative areas in Zambia with the smallest area being the district. Population figures for facility level were then obtained from district health offices. Akros played an important role for obtaining access to these data. The data was sent to Akros and then it was shared with me. The data obtained was not from all 103 districts. Akros has been contracted to target certain identified weaknesses and strengths in 11 districts as part of

Millennium Development Goal Initiative (MDGI) project. For this reason, Akros was able to get population data from these districts. The documents sent in Microsoft Excel and contain catchment population for each health facility located in each district and also the total population of the districts. The list of 11 districts are in the table below. The data obtained was from 5 out of 8 districts in Lusaka province, and 6 out of 10 districts in Copperbelt province only for the year 2016.

**Table 4.4 - List of districts for comparison**

| Province | District | Province | District |
|---|---|---|---|
| Lusaka | Lusaka | Copperbelt | Masaiti |
| | Rufunsa | | Chingola |
| | Chilanga | | Mufulira |
| | Chongwe | | Luanshya |
| | Kafue | | Kitwe |
| | | | Ndola |

On the other hand, after discussion through e-mail, PATH agreed to send their estimation of population data to both Akros and me. The data sent in Microsoft Excel and contains population figures for all 103 districts. This data was obtained before the interview and therefore it could be discussed when the interview was conducted.

## 4.5 Data analysis

The purpose of data analysis is to examine the data in detail and methodically in order to explain and interpret it. Additionally, data analysis can discover and reveal something through close examination. According to Crang and Cook (2007) data analysis is performed to make formal sense of empirical material obtained through the field work by looking at it and reconsider the data carefully and critically. In interpretive case studies, data analysis is constructed by the reflections of the researcher supplemented by the minds of others (Walsham, 2006). This thesis adopted a looser approach as suggested by Walsham (2006) that the analysis process is not guided by universal rule and is relatively unplanned process. Reflections started early in the research process. Each reflection after each data collection informed the next discussion or data collection step. Therefore qualitative analysis is a fluid process that involves focusing and refocusing research aims, subjects in the interviews, and whom the researcher chooses to involve.

**Record and process data immediately**

As soon as data collected, it is critical that I immediately process the information and make detailed notes. It is helpful to this while the interaction is still fresh. Interview and field notes were initially written on paper during the data collection. During the day after interview, the notes were then written up in a more organized sentences. Reflections such things that stuck out to me was also added on the notes.

**Review the data**

When the first pieces of data are collected and after making more organized notes, I began reviewing them and mentally processing them for themes and patterns that were exhibited. It was important to do this early so I could focus on these themes as they appear in subsequent data collected. When trying to discern what is meaningful, it was helpful to always refer back to research questions and use them as framework. As doing analysis, there are questions always kept in mind when understanding the data such as *how exactly do they do this?,* or *how do the interviewees talk about and understand what is going on?*

**Use of diagram**

Structuring the notes also involved the use of diagram so that the data is easily understood. As suggested by Goodman et al. (2012), framing the situation can be done through taxonomies, timelines, maps, matrixes, and flowcharts. Displaying the situation in this thesis was for example by making a hierarchy diagram showing the general situation of who provides population data and at which level both in administrative and health system level. This situation is shown in diagram below.

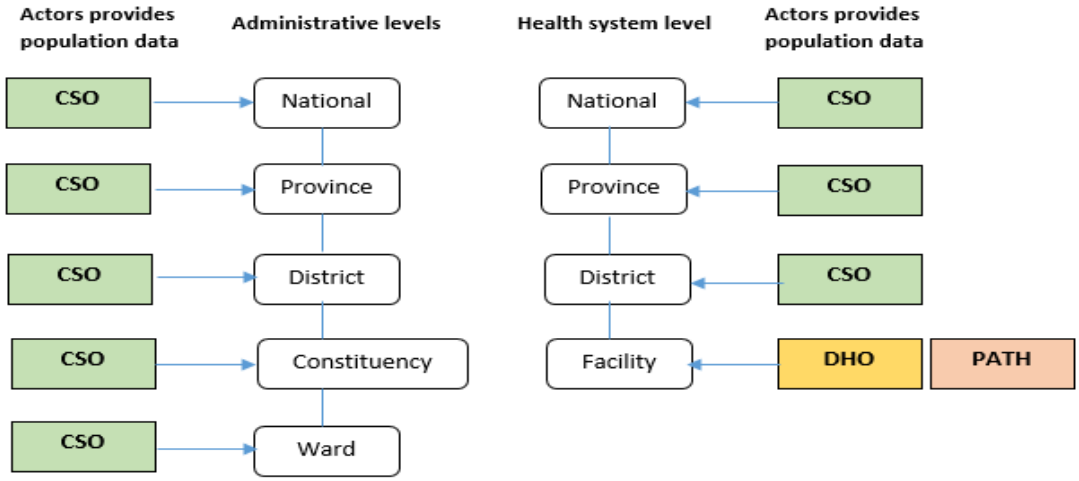


**Figure 4.1 Actors providing population data at each level**

Notes: CSO: Central Statistical Office, DHO: District Health office

**Grouping the themes**

After the field notes were developed into coherent and manageable write-ups and reviewed, the data was grouped into different categories under subjects that were studied: PATH, HMIS/DHO, and CSO. Themes that were identified include *background, challenges, estimation method,* and *population comparison.* This cross-subject analysis was done to find patterns as in similarities or differences between the subjects for each theme. Cross-subject comparisons allows the researcher to seek out what is common and what is particular in the subjects (Stake, 2005). This analysis is then displayed through a matrix with keywords and findings.

**Table 4.5 - Categories and themes in data analysis**

| Categories / Themes | CSO | PATH | HMIS/DHO |
|---|---|---|---|
| background | • 2010 census<br>• Administrative level population | • CSO as source of district population<br>• Does own catchment population projection for their projects | • CSO as source of district population<br>• DHOs do the estimation important for HIS |
| challenges | • Census is costly<br>• The projections are not updated | • The projections from CSO are not updated since new districts creation | • The projections from CSO are not updated since new districts creation |
| estimation method | • Annual projections for administrative level population | • Divide district population to facilities within the district<br>• Proxy measures for estimating the proportion each facility gets | • Divide district population to facilities within the district |
| population comparison | • Comparing through statistical analysis at district & facility level | | |

Writing up the findings of case study can be done thematically or chronologically. The findings in this thesis were written thematically using the themes identified as the guide. It

is not always necessary to write up findings under each theme. The headings of findings can be established in a more descriptive way or sometimes two themes can be described under one heading. The following are the primary headings that were established as the key focal points for case study narrative. These serve as framework how findings were presented.

- General background and current status of population data
- Methods used by two sources (District Health Office and PATH) to estimate facility catchment population
- Comparisons of population figures at district and facility level

**Statistical analysis**

The analysis on population figures consists of two parts. First, comparison of district population between 3 sources (CSO, DHO, PATH), and second, comparison of facility catchment population between 2 sources (DHO and PATH).

Analyzing the population figures started by making a new Microsoft Excel spreadsheet for comparison, one spreadsheet for facility level and one spreadsheet for district level. The comparisons are done on the data from 2016. One of the issues was many of the facilities in documents from PATH and District Health Offices do not have the same names. To identify which facility, looking at facility UID proved to be useful. The table was then categorized by province, district, facility name, type of facility, facility UID, and population from PATH, population from DHO, value difference, and percentage difference. Example of the Microsoft Excel spreadsheet for comparison is shown in the figure below.

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Provinc | District | Facility Name | Type of Facility | Facility UID | PATH | DHO | Differenc | % Differen |
| 2 | Lusaka | ls Lusaka District | ls Airport | Urban Health Centre | nPgSY7DnQl0 | 4644 | 6991 | 2347 | 50.54% |
| 3 | Lusaka | ls Lusaka District | ls Bauleni | Urban Health Centre | cENHiNyGXZA | 26846 | 88541 | 61695 | 229.81% |
| 4 | Lusaka | ls Lusaka District | ls Cancer Diseases Hospital | Hospital | uYLa8Xuof0w | 6821 | | | |
| 5 | Lusaka | ls Lusaka District | ls Chainama Hills | Hospital | NtOvzfyPBdS | 6821 | | | |
| 6 | Lusaka | ls Lusaka District | ls Chainama Urban Health Centre | Urban Health Centre | P2sINO0afU2 | 202634 | | | |
| 7 | Lusaka | ls Lusaka District | ls Chainda South Clinic | Clinic | FyEYUDmn61s | 5035 | | | |
| 8 | Lusaka | ls Lusaka District | ls Chainda Urban Health Centre | Urban Health Centre | e3vlJ4RcVHY | 41355 | 50910 | 9555 | 23.10% |
| 9 | Lusaka | ls Lusaka District | ls Chaisa | Urban Health Centre | wrdjeWiE0qA | 77956 | 77473 | 483 | 0.62% |
| 10 | Lusaka | ls Lusaka District | ls Chawama | Urban Health Centre | Hl6F6xRjZO1 | 190229 | 137238 | 52991 | 27.86% |

**Figure 4.2 Table of catchment population comparison**

A common way to analyze numerical data is by using statistics. Statistics is the field of science concerned with the theories and techniques that have been developed to manipulate data. Statistical analysis was performed to compare two values: population figures between DHO and PATH. The purpose of comparing data is to explore differences and similarities. In order to do this, the difference between two values can be presented in percentage. The formula to calculate the percentage difference can be seen as follows.

$$percentage\ difference = \frac{|\ V1 - V2\ |}{V1} \times 100$$

Notes: V1 = value 1, V2 = value

In this case, there is no obvious way of choosing which value is V1 or V2 since there is no old value or new value. For this study, PATH was chosen as the V1, and DHO as the V2, and therefore we can say that PATH is the reference value. Reference value is used as the basis when reading the percentage difference. This means HMIS value is either a certain percent higher or lower than PATH. Another way to say this is we wish to calculate how far DHO differs from PATH value. It can be lower or higher but the point here is we calculate the distance.


**Figure 4.3 Illustration of value difference**

Calculating the difference in raw values does not prove useful because there are facilities who work with population of thousands and facilities who work with population of tens of thousands. The idea is to put the result in the form of parts per 100 by using the percentage difference so that it is readily understandable and comparable.

# 4.6 Reflections

The thought behind this section is to describe the limitations that arose when I chose to do research in this particular setting. Case study is a popular research methodology because of its strengths and broad applicability but it must be selected with caution. As warned by Myers (2009), to gain access to the target population can be difficult. This was also the case in my study. Research in health sector often finds difficulty in persuading the right people to participate in the study especially when the researcher is considered as an outsider. Another constraint is the difficulty to prompt the people to give up their valuable time without understanding the value that the study offers to them (Myers, 2009). More importantly, the access is often constrained because of political reasons or much of the data is deemed sensitive. In order to have access to interviews and visits, a letter of proposal was made and sent to the Permanent Secretary in the Ministry of Health. This was done in the first week of the field work after consulting with a manager in Akros. Since the field work only lasted for 4 weeks, it was regarded as the best and fastest way to gain permission by

sending a proposal letter as a representative from Akros. In the letter, the thesis was introduced as part of HMIS strengthening project conducted by Akros. Having Akros as the channel was thought to be useful and could become leverage to facilitate access. Unfortunately, the result did not turn out as expected. The permission to conduct interviews and health facilities visit was not granted. The Ministry of Health expected the students to send a letter of proposal to the Research Board instead. Since the decision was received already in the third week, there was not enough time to send a new letter. What we initially considered to be a beneficial effect turned out to be limitations.

This had an impact on data collection process. The interviews with health facility managers could not be conducted and there was no visit allowed to the health facilities. The visits could have proved useful to gain an insight on how the facility workers use the population data to calculate health indicators at facility level every month. Doing an observation while they are calculating indicators using population data could have been a great supplementary data for the study. Because of this limitation, the firsthand experiences of people who are actually using the population data for report or monthly analysis at the facilities were left out. Not having a granted permission from MOH also made gaining access to interviews in district health offices difficult. Since there is a strong partnership with Akros, a DHIO was willing to have an interview. Therefore despite the amount of data collected there are some questions that are unanswered, such as the exact formula used to calculate the facility catchment population by the district health offices. Although the general method was obtained, it still does not tell the whole story.

Furthermore as Myers and Newman (2007) state that *"the more comfortable interviewees are, and the more they are prepared to open up and talk, the better the disclosure is likely to be".* A limitation to this could be that interviewees in district health offices were not comfortable speaking in detail without a granted letter of proposal. The interviewees may understandably be reluctant to share information with an external researcher and point out weaknesses about their work. When asked about the differences on population data, the interviewees were reluctant to give explanation in detail. It was understandable as this could be seen as a critic to other government organization or their workplace.

The data collection process is generally dependent upon the competence of the researcher. Having relatively little experience in conducting interviews in natural settings, there are things to be kept in mind such as being able to ask relevant and well-structured questions, listen and find balance between over-direction and passivity (Walsham, 1995). In spite of best efforts during the data collection process, there were few things that could not be captured such as getting a quote. This due to the interview not being able to be recorded. During the interview, there were also occasions when some of the informants spoke at a low volume. Because of that, making sense of their interpretation was not a trivial

task. Additionally, it was necessary for me as a researcher and the ones being researched had a common understanding of the subject in question (Crang and Cook, 2007). This includes the terminology, for example the term used in this thesis is catchment population, and some of the interviewees used service population or target population. It was important that we understood the same thing.

Lastly, in regards to ethical considerations, sensitive information that could identify the informants was not written down and the informants were represented anonymously. Personal information on the informants was deemed not necessary for this study. According to Cohen et al. (2007), ethical consideration should be maintained as interviews are considered an intrusion into respondents' private lives with regard to time allotted and level of sensitivity of questions asked. Therefore participants were told that their participation in the interview was entirely voluntary and that they could withdraw at any time. The consent was given verbally before the interviews began.

# Chapter 5

# Findings

The purpose of this chapter is to present findings from carrying out the case study described in Chapter 4. This chapter starts with a description of general background and the current status of the population data in Zambian health sector. The next section describes methods for estimating facility catchment population from two different sources which are DHO and PATH. The last section of this chapter presents the findings from comparison of population figures at facility level from the abovementioned sources as well as district level which includes CSO as the additional source.

## 5.1 Background and status of population data

### 5.1.1 Census of Population and Housing

Population data in Zambia comes from the censuses that are conducted once every 10 years. The official government organization who is responsible for undertaking the census is CSO. As of today, CSO has undertaken five censuses from year 1969, 1980, 1990, 2000, and 2010. The census is named Census of Population and Housing and is carried out by different branches under the Social Statistics division in CSO. Three branches forms the fundamental of the census are Population and Demography Branch who conducts the census and surveys activities, Geographic Information Branch who designs and produces maps to use during the census and surveys activities, and Labor Statistics Branch who produces statistics on labor force size and distribution as well as numbers on employment and unemployment.

The most recent census was conducted in 2010 between 16$^{th}$ October and 15$^{th}$ November. By 30$^{th}$ November, the complete enumeration of the census process was achieved. The processing of data collected from the census began in April 2011. During the census, demographic data was recorded from 13 million people using 3.2 million questionnaires. Questionnaires were done on paper, and then to capture the data during processing, Optical Mark Reading (OMR) was used. This device helps scan document forms that are often used as surveys or examination paper. The census was conducted by a team of approximately 8,400 teachers and other civil servants who worked as Census Supervisors, about 25,000 school leavers that had completed Secondary School Education within 2-5

years who worked as Census Enumerators. 400 civil servants were coming from various government departments and ministries acted as Master Trainers, Assistant Master Trainers, and Provincial Census Officers. One of the objectives of the census was to provide information on the demographic and socio-economic characteristics of the population of Zambia at the lowest administrative level – the wards.

The process of census went like this. Census enumerators visited all the buildings in Zambia whether they are habitable, inhabitable, abandoned, completed, or incomplete. This was done in order to identify the characteristics of all households, buildings, and other human aspects. All people that lived in the buildings were counted and information related to their characteristics was recorded. This includes information pertaining to age, gender, and occupation among other things. However, not all persons were present during the enumeration visit. People who were present at the time of the visit were recorded and counted into Usual Household Members Present. Detailed personal information was collected from people who were present. Those who were not present were counted as Usual Household Members Absent. Only age, sex, relationship to household head, and residence status were recorded by proxy from the main respondent in the household. Usual Household Members Present together with Usual Household Members Absent produced True Population or De Jure Population. However, since the detailed information was collected from only people who were present, detailed analysis of the population by background characteristics could only be done based on Usual Household Members Present because it is the population from whom details in questionnaires were collected during enumeration. As a result, there are some analysis that cannot be produced due to incomplete data.

Previous census in 2000 did not include the questions on deaths and cause of deaths of Household Members during the 12 months period prior to visit, while the 2010 census included those questions. This means a more detailed questions was used during the last census, however at the same time this indicates that longer questionnaires were required. As a result, enumerators spent longer time on each enumeration visit.

The government of Zambia had financial support from various international organization in order to undertake and complete the census. The census was funded by United Nations Population Fund (UNFPA), the United Kingdom AID (UKAID), the United States Agency for International Development (USAID), and the African Development Bank (AFDB). This external funding contributed approximately 60% of the total expenditure. The rest of the budget was coming from the Ministry of Finance.

## 5.1.2 New districts creation

During the interview, PATH analysts mentioned that creation of new districts was one of the challenges that makes estimation difficult. The new districts creation was done after the census and therefore adjustment had to be made in order to come up with a new number for

newly created districts. Some districts were created by dividing old district without altering the existing boundaries and some districts were created by cutting the boundaries. The government of Zambia has also created a new province in October 2011 namely Muchinga Province. But in this case, population total for the new province was easily extracted because the province was created by taking the whole districts without changing the boundaries, which means Northern and Eastern Province are lower due to the loss of 4 and 1 districts respectively to Muchinga Province. However for the cases where newly created districts cut across multiple old districts, the estimation is challenging since the boundaries have to be made new and it is almost impossible to know exactly how many people live in each side of the boundaries.

### 5.1.3 Status of population data

The information gathered from the 2010 census has been used by many other government organizations including the MOH. Based on the 2010 census, CSO has made annual projections of population data for national level down to district level. The result of the census in 2010 was analyzed and put into a document by CSO called *Population and Demographic Projections 2011-2035.* The projections are going to be used until the next census in 2020. The census covered each household in the country but the population data is only available down to district level. The number of population based on constituencies and wards are not presented in the document. As a result, there are no projections for administrative levels below district. During the year 2011, Post Enumeration Survey (PES) was conducted to evaluate 2010 census. The result showed that population data from census does not cover 100 percent of total population in Zambia. It indicates that 92.7% of the residents in the country were captured and therefore it represents undercount of 7.3%.

The MOH has used the population data from CSO for a basis to develop planning and policies. National, province, and district level in health system can use the available population data from the census. Naturally the health indicators at those levels can be easily produced using the available population that is broken down in detail based on age (single years and age groups) for each sex. As a result, health managers at those level can see how many women there are in age group of 25-29 for example, or how many children there are in age group of 0-4. However, the facility level in health system does not have the population from CSO. CSO is not responsible for making an estimate for facility level as this is not an administrative area. The boundaries of facility catchment areas are also not imposed by the central government but are mandated to the MOH. District level has taken the responsibility for estimating the catchment population for each facility within the district. The DHOs usually appoint their DHIOs together with District Health Planners (DHPs), and District

Community Medical Officers (DCMOs) and a number of other staff to do and oversee the estimation.

PATH has worked in Zambia since 2005 and helped solve health challenges mainly on malaria prevention and control, as well as some other pressing health challenges such as HIV and malnutrition. PATH works side by side with clinics and community health workers to fight disease and improve critical data-informed decisions about how and where to tackle outbreaks. This leads to the need to monitor their specific programs and how facilities performed. That is why having facility catchment population would help to identify how the facility performs by monitoring the coverage of the program. For this reason, PATH also makes estimation for facility catchment population that is used by them in order to monitor their own programs. During the interview, it was then mentioned that PATH calculated catchment population using their own method and then put them in their own database in DHIS2.

From this revelation, now there exist multiple sources of facility catchment population in Zambian health sector. The MOH evidently uses the estimates coming from the District Health Offices since these are recognized as official. It is also possible that other NGOs that are working in the Zambian health sector make their own estimations. Since each health program intervention ultimately will report their indicators to health facilities and District Health Office, the Facility and District Health Managers will receive indicators that do not use the same denominator data.

Poor quality of population data has been the concern of many health authorities in Zambia and there has been a few attempts conducted to evaluate the existing population data in hopes of producing a more updated estimate. The MOH together with CSO conduct ZDHS every 5 years. This survey uses sampling techniques, and while it does not provide number of population, it produces indicators such as mortality rates among others. A few of Akros' staff has also examined the population data for health facility level briefly in 2016, and found out that there was a mismatch between the finding and what DHO informed. A DHO staff informed Akros that the reference for estimating facility catchment population was ward population instead of district population. However, that was not the case when DHO sent out the document containing the calculations. When this information was followed up during this current research, the finding remained the same, and it seems that there is confusing information in district health offices as to which population is used as the reference.

In summary, three sources who provide population data for Zambian health sector are identified. Firstly, CSO has the role in providing the population data based on census and provide population down to district level. Secondly, DHOs has the role to estimate catchment population for facility level, and thirdly, PATH who evidently estimates catchment population for facility level using their own method.

## 5.2 Population data for comparison

Before moving on to comparison, this section will describe what kind of data that I have obtained from each source. I received population data from PATH for 103 districts, while from District Health Offices for 11 districts. The comparison then will be done between the 11 districts which I have been provided data for. There are two kinds of population data that I gathered, which are population data at district level and facility level. The summary of the data that I gathered from each source will be presented in the table below. Each column represents a source and the rows show how the sources gather data at a district and facility level.

**Table 5.1 - Population data obtained for comparison from three sources**

| Level | CSO | PATH | DHO |
|---|---|---|---|
| **District** | Obtained.<br><br>CSO made projections based on 2010 census.<br><br>Gathered from the document *Population and Demographic 2011-2035* released by CSO in 2013. | Obtained.<br><br>PATH uses projections from CSO.<br><br>PATH made their own estimation for the new districts and the districts that are affected. | Obtained.<br><br>The DHOs use projections from CSO.<br><br>With the help from CSO, DHOs estimates new district population |
| **Facility** | Not available.<br><br>CSO does not have estimations for health facility catchment population. | Obtained.<br><br>PATH divides district population to the facilities within the district. Each facility gets certain proportion of district population. | Obtained.<br><br>The DHOs divide district population to the facilities within the district. Each facility gets certain percentage of district population. |

District level comparison will be done on population data that is available for 11 districts and the facility level comparison will be done on health facility catchment population within those 11 districts. In total, there are 362 health facilities gathered from both PATH and the DHOs from those 11 districts.

## 5.3 Methods for estimating catchment population

Population figures are available in three administrative areas: national level, provincial level, and district level. These figures are from CSO and available publicly, therefore the District Health Offices and PATH have access to this district level population but the population below that level is unknown. The task is then to determine the population given to each health facility. The DHOs and PATH use similar approach to estimate facility catchment population. They both divide the district population to each facility located within the district. However, they differ in terms of determining the percentage or the proportion each facility can get.

### 5.3.1 DHOs' method of estimating catchment population

The idea of the method is to divide district population and allocate a certain amount of population to the facilities located within the district. Each facility gets different proportion that is represented as percentage. The DHOs then determine the percentage each facility gets. For instance, Chilanga District total population is 137,780 and Makeni Rural Health Centre gets 17% which is 22,045 and Chilanga Urban Health Centre get 15% which is 20,667 and the rest is distributed to the rest of facilities with different percentage. The DHOs did not reveal how exactly each facility's percentage was determined. However, a DHIO interviewed explained that there are some factors of why each facility has different catchment population than the others. The first factor is the service demand of the facility. From the type of facility, the amount of people who need and would come to seek the service can be predicted. Following the guide from the MOH as described in Section 2.2.1, health posts cover the least catchment population and hospitals cover bigger population. A hospital typically provides different services than clinics, and thus the catchment population will be shared because people attend both hospital and clinic, depending on their needs. Because health facilities are not always of the same type and size, consequently the district population is not distributed equally. The second factor is the density of the area where the facility is located. For example, a clinic that is located in a low density area may have lower proportion compared to the clinics located in highly populated area. However if that clinic has good accessibility for example by public transport or if it is located near another destination that naturally attracts a lot of people daily such as a market, then that clinic may

not have lower proportion. Furthermore, a clinic that is surrounded by a lot of residences may have bigger proportion because it is close to the patients' homes.

This DHIO further added, that previously the District Health Offices conducted a survey in order to know better about the target population and to help estimate the catchment population. District Health Offices appointed one of its departments, Department of Environmental Health together with health facility workers to run the survey which was called *environmental community data survey*. The survey did not only include headcounts in the community but also includes monitoring on the services located in the community such as school, water, and bus. This survey was considered a good way to understand more about what the communities actually need so the health facilities could monitor what happened in the community. This survey was done very close to the residents as the surveyors visited households and enquired what the residents needed. As a result, the health facilities could figure out the target population and this helped them estimate the number of people that the facility served. This survey was discontinued because the funding was suspended. It was concluded that this independent survey was very costly since many workers were involved and the travel was exhausting. However it is unclear if the result from this survey is used for reference for facility catchment population estimation.

After the District Health Offices estimate the catchment population, the data is sent to the health facilities. The 2016 catchment population that I have received, many have not been entered in DHIS2. The district health offices are responsible to enter population data into DHIS2. The health facilities receive the catchment population by paper or sometimes e-mail. Monthly aggregation is therefore done manually at the facilities and then sent to the district health office. Since most of population data is not on DHIS2, the indicators calculation is usually done using Microsoft Excel.

### 5.3.2 PATH's method of estimating catchment population

PATH estimates facility level population by looking at service data from each facility. PATH created an average measure that is related to the number of people that are served by a facility. This measure called *proxy measure* is then used as a proxy for proportioning district population to the facility level. The service data that they looked at was monthly OPD attendance. The other data that may be used is vaccinations if the data is deemed more comprehensive. Other data could be used if it reflects the natural pattern of the facility. PATH made the estimation in 2012 using 2011 facility data and 2010 census. Afterwards, the catchment population for the latter year is estimated using growth rate. PATH also adjusts the calculation of proxy measure using new OPD data regularly. From the spreadsheets gathered, it indicates that they adjusted estimation in 2015. The method begins by finding the average OPD attendance of each facility and that becomes *proxy measure.*

The next is find the sum of average OPD attendance of all facilities within district and that becomes *district proxy measure.* The district population is obtained from CSO. Finally, the catchment population can be acquired through this formula:

$$catchment\ population = (\frac{\text{proxy measure}}{\text{district proxy measure}}) \times district\ population$$

# 5.4 Findings from population figures comparison

This section presents the findings from the comparison of population figures at the district and facility level. The complete list of facility level comparison is provided in Appendix A.

## 5.4.1 District level comparison

After gathering all district population that was received from CSO, PATH, and the DHOs, comparison was done using spreadsheet on Microsoft Excel. Below is the table showing the population from each source at district level. Some of the rows are empty because the population are not in the CSO's document from 2010 census.

**Table 5.2 - District level comparison**

| **Province** | **District** | **2016 Population by** | | |
|---|---|---|---|---|
| | | **CSO** | **DHO** | **PATH** |
| Lusaka | Lusaka | 2,330,200 | 2,301,840 | 2,330,199 |
| | Rufunsa | | 63,921 | 79,136 |
| | Chilanga | | 137,780 | 144,381 |
| | Chongwe | | 172,827 | 157,617 |
| | Kafue | | 284,323 | 148,771 |
| Copperbelt | Masaiti | 117,393 | 117,456 | 117,394 |
| | Chingola | 266,478 | 266,477 | 266,477 |
| | Mufulira | 188,444 | 188,440 | 188,443 |
| | Luanshya | 173,335 | 173,335 | 173,335 |
| | Kitwe | 668,668 | 668,668 | 668,667 |
| | Ndola | 540,923 | 540,921 | 540,925 |

Kafue district population comparison (highlighted in blue) shows an extreme difference. The analysis indicates that a hospital in Kafue has 84% of the district population,

which means the catchment population of that hospital is overlapping with the other facilities. The other DHOs do not have overlapping catchment population for their facilities.

Rufunsa, Chilanga, Chongwe, and Kafue districts are the districts that are affected by the creation of new districts after the census 2010. At the time when the new districts were established in 2012, CSO had not made any new estimations for the new districts. In order to come up with new districts population, PATH did their own estimation by sharing the population of old district to new district that was created from inside the area of old district. For example, during 2010 census, Rufunsa was not yet in place because it was still part of Chongwe district. What PATH did was giving a certain estimate of Chongwe District population to Rufunsa District. This scenario was done also to Chilanga which was part of Kafue District. However from census in 2010, the projections were made by CSO for the old districts Chongwe and Kafue for 2011 to 2035. After 2012 when the new districts were created, the projections obviously were not relevant anymore. This table below shows CSO projections for year 2016 that were made for old Chongwe and Kafue districts. If we calculate the total population of Rufunsa and Chongwe from DHO's estimate, it produces the total population that is almost the same with old Chongwe district. This is the same case as we calculate from PATH's estimate. However, DHO's estimates for Kafue and Chilanga district do not give the total population that is even close to the population of old Kafue district, while PATH's estimates produce total population that is close.

**Table 5.3 - Comparison of newly created districts population**

| **Old district** | **New district** | **2016 Population** | | | | |
|---|---|---|---|---|---|---|
| | | **CSO projection** | **DHO** | **Total** | **PATH** | **Total** |
| Chongwe | Chongwe | 236,749 | 172,827 | 236,748 | 157,617 | 236,753 |
| | Rufunsa | | 63,921 | | 79,136 | |
| Kafue | Kafue | 293,149 | 284,323 | 422,103 | 148,771 | 293,152 |
| | Chilanga | | 137,780 | | 144,381 | |

CSO is the official organization who is responsible to estimate total population whenever there are new districts created and it is possible that CSO works together with the District Headquarters. For this reason, the District Health Offices do not make their own estimate for the new districts because they are not responsible for estimating population for administrative areas. They receive these population from the CSO. However CSO has not updated the document *Population and Demographic Projections 2011-2035* with the new districts population.

If we look at the comparison for districts in Copperbelt province, there are no districts with large differences. Lusaka district population from DHO however shows that it

has large discrepancy compared to CSO and PATH, even though the population was said to be coming from CSO. Large differences are shown in districts affected by the creation of new districts. This indicates that DHO and PATH use different method to estimate the allocation for new districts and the remaining population for the old districts.

## 5.4.2 Most extreme cases at facility level

This section presents comparison of facility catchment population between PATH and DHO. The whole comparison for all health facilities was done on spreadsheet on Microsoft Excel and from that the ranking of differences can be made. The table below shows the 5 largest discrepancy found in the comparison. As previously explained in Chapter 3, PATH is the reference value so the comparison shows that DHO is either higher or lower than PATH.

**Table 5.4 - Extreme differences at facility level**

| District | Facility | Type of facility | PATH | DHO | Difference |
|---|---|---|---|---|---|
| co Kitwe | Itimpi | Urban Health Centre | 490 | 10,159 | 1973.27 % |
| ls Kafue | Kafue | Hospital | 15,170 | 130,510 | 760.32 % |
| co Kitwe | Chilobwe | Rural Health Centre | 760 | 5,241 | 589.61 % |
| co Luanshya | 73 Independence | Urban Health Centre | 557 | 3,467 | 522.44 % |
| co Kitwe | Community Development College | Health Post | 947 | 5,709 | 502.85 % |

Notes: co: Copperbelt Province, ls: Lusaka Province

The finding shows that there are no single facility catchment population that has the same population figure. The largest difference between PATH and DHO is at Itimpi Urban Health Centre located in Kitwe District in Copperbelt Province. The largest discrepancy indicates that DHO's estimate is 1973.27% higher than PATH's estimate. If we look at the figures, DHO's figure is approximately 20 times bigger than PATH's. The comparison here also shows that DHO's estimates are all higher than PATH's.

### 5.4.3 Most similar cases at facility level

This section shows the finding from comparison that indicate low differences between PATH and DHO. The table below presents the 5 lowest discrepancy for facility catchment population.

**Table 5.5 - Similar cases at facility level comparison**

| District | Facility | Type of facility | PATH | DHO | Difference |
|---|---|---|---|---|---|
| co Masaiti | Kaloko | Rural Health Centre | 7,052 | 7,044 | 0.11 % |
| ls Lusaka | Chaisa | Urban Health Centre | 77,956 | 77,473 | 0.62 % |
| co Ndola | Masala | Urban Health Centre | 10,852 | 10,726 | 1.16 % |
| co Masaiti | Michinka | Health Post | 2,393 | 2,348 | 1.88 % |
| co Luanshya | New Town | Urban Health Centre | 4,422 | 4,333 | 2.01 % |

The lowest difference between facility catchment populations is found at Kaloko Rural Health Centre located in Masaiti District in Copperbelt Province. The difference is 0.11% and the value difference is only 8 between 7,052 and 7,044. These numbers shown in the table are very similar. However there are only 2 facilities that indicate differences lower than 1% (Kaloko and Chaisa). The rest of the facilities have differences ranging from 1.16% up to 1973.27%.

## 5.5 Overall comparison

This sections presents finding in other aspects such as list of facilities, disaggregation of population data from DHO and PATH, and general differences from population figures comparison, as well as inconsistency found in the spreadsheets.

### 5.5.1 Distribution of percentage differences

As previously mentioned, there are 362 health facilities found after gathering the data from PATH and the DHOs from 11 districts. However, PATH and DHOs do not have the same list of health facilities in each district. The comparisons were then done between 226 health facilities that only exist in both PATH and the DHOs lists. The ranking was also applied

from these facilities. So overall, PATH has longer list of health facilities compared to the DHOs. Below is the statistics of available health facilities.

**Table 5.6 – Statistics of health facilities**

| **PATH** |
|---|
| Number of health facilities PATH has = 344 |
| Number of health facilities PATH missing = 18 |
| Total population = 4,815,345 |
| **DHO** |
| Number of health facilities DHOs have = 244 |
| Number of health facilities DHO missing = 118 |
| Total population = 4,915,986 |

We can see that PATH divides 4,815,345 to 344 health facilities, while the DHOs divides 4,915,986 to 244 facilities. Having less population and more health facilities means that on average, PATH estimates lower catchment population per facility.

The frequency of percentage differences can be seen in the chart below.

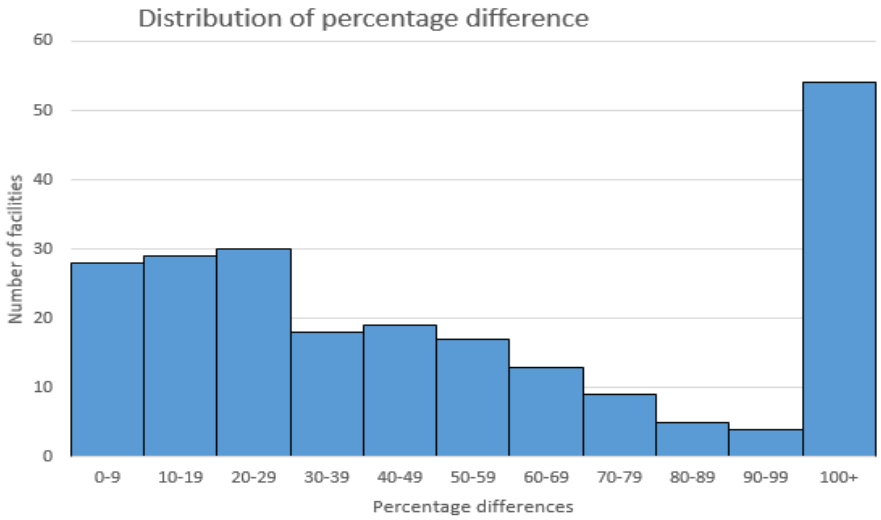


**Figure 5.1 Distribution of percentage differences of health facilities catchment population**

More than 50 health facilities have differences larger than 100%. These large differences values could be immediately disregarded due to being unreliable or too extreme. The rest of the distribution shows that most facilities are working with a percentage difference of between 0 and 30 percent, with the exact count of 87 facilities. The exact count of health facilities that have differences larger than 100% is 54. From this we can tell that distribution is favoring the facilities with a relatively low difference percentage.

## 5.5.2 Disaggregation of catchment population

The spreadsheets that were received from the DHOs contains the facility catchment population that is broken down to specific age groups and sex. Some of the DHOs also include population figures for expected pregnancies, expected deliveries, and expected live births. It also shows the percentage that each health facility gets. However, not all DHOs provide this kind of disaggregation. This may indicate that they haven't calculated it yet and the health facilities are not provided with the updated population disaggregation.

| **Luanshya Population** | Total Population | Facility % | UID | 2016 | Form. | 0-5 Months | 6-11 Months | Under 1 year | 1-5 Years |
|---|---|---|---|---|---|---|---|---|---|
| **FACILITY** | 100% | | | | | 2% | 2% | 4% | 16% |
| 73 INDEP | 173,335 | **2.0** | **jGqu6BUf5hW** | 3,467 | 22 | 69 | 69 | 139 | 555 |
| ALLESSANDRAS | 173,335 | **4.0** | **FrvBobvFmr2** | 88,541 | 22 | 1771 | 1771 | 3542 | 14167 |
| BALUBA | 173,335 | **1.0** | **l8MgRrAGJWM** | 50,910 | 22 | 1018 | 1018 | 2036 | 8146 |
| CHAISA | 173,335 | **8.0** | **cmraRWSOEAq** | 77,473 | 22 | 1549 | 1549 | 3099 | 12396 |
| CHILABULA | 173,335 | **1.0** | **bBBYvLHoyax** | 137,238 | 22 | 2745 | 2745 | 5490 | 21958 |
| FISENGE | 173,335 | **6.0** | **jtZRrvRDu4m** | 44,271 | 22 | 885 | 885 | 1771 | 7083 |
| FRANCO | 173,335 | **4.0** | **iAdmFLZxDJx** | 117,317 | 22 | 2346 | 2346 | 4693 | 18771 |
| KAFUBU BLOCK | 173,335 | **4.0** | **hecsfCuiUk4** | 110,676 | 22 | 2214 | 2214 | 4427 | 17708 |
| KAWAMA | 173,335 | **3.5** | **K56EnqjGlYu** | 6,067 | 22 | 121 | 121 | 243 | 971 |
| MAIN | 173,335 | **8.0** | **SIXxeT0d3bJ** | 13,867 | 22 | 277 | 277 | 555 | 2219 |

**Figure 5.2 Example of spreadsheet received from the DHO**

## 5.5.3 Data inconsistency

Data inconsistency was found in the some of the spreadsheets received from the DHOs. As mentioned before, Kafue District has inaccuracy in terms of calculating the total population of the district. The percentages in total do not show 100% as shown in the table below.

**Table 5.7 – Special case for Kafue district population**

| Facility name | Total Population | Facility % | Catchment population |
|---|---|---|---|
| Chanyanya RHC | 155,369 | **7.0** | 10,876 |
| Chiawa RHC | 155,369 | **3.0** | 4,661 |
| Chikoka Health Post | 155,369 | **2.0** | 3,107 |
| Chikupi RHC | 155,369 | **5.0** | 7,768 |
| Chipapa RHC | 155,369 | **6.0** | 9,322 |
| Chisankane RHC | 155,369 | **6.0** | 9,322 |
| Estate UHC | 155,369 | **19.0** | 29,520 |
| Kafue Dist Hospital | 155,369 | **84.0** | 130,510 |
| Kabweza Health Post | 155,369 | **2.0** | 3,107 |
| Kafue Mission RHC | 155,369 | **6.0** | 9,322 |
| Kambale RHC | 155,369 | **4.0** | 6,215 |
| Mugurameno Health Post | 155,369 | **2.0** | 3,107 |
| Nangongwe | 155,369 | **14.0** | 21,752 |
| Railway UHC | 155,369 | **15.0** | 23,305 |
| Shimabala Health Post | 155,369 | **5.0** | 7,768 |
| ZNS Kafue | 155,369 | **3.0** | 4,661 |
| **Total** | | **183 %** | **284,325** |

Kafue district health office uses 155,369 as the total population of district and the basis of estimation. As described in the interview, the DHOs receive district population from CSO and therefore it can be assumed that this figure is an estimation from CSO. However, the total catchment populations do not have the same figure as the district population. Catchment populations in total produce 284,325. If we look at the percentage Kafue District Hospital gets, 84% is quite large proportion. The remaining 16% is divided to the rest facilities. Kafue District Hospital is most likely taking population that is overlapping with some of the other facilities. As a hospital, the facility naturally has large catchment population. However, this is inconsistent compared to the other districts who do not give overlapping catchment population between the facilities. The total percentages from the other DHOs for each district amount to 100%.

### 5.5.4 Trend in population comparison

Overall comparison shows that district level population figures do not have extreme discrepancies between CSO, PATH, and the DHOs, with an exception of the districts that are affected by the new districts creation, and Kafue District. On the contrary, facility catchment population comparisons show that there are large differences between estimates from PATH and the DHOs. At the same time, there are health facilities that have almost the same population figures. The differences vary in facility level comparison. Overall, the DHOs estimate higher populations than PATH. Out of 226 health facilities compared, there are 146 health facilities from DHOs that have higher figures, and 80 that have lower, than PATH.

# Chapter 6

# Discussion

The purpose of this chapter is to consider the findings of the research and the implications of these. This chapter also provides discussion of the findings in the light of relevant literature. Firstly, summary of differences from population data comparisons done at district level and facility level will be presented. The reasons as to why the differences occur will be provided in the next section. Furthermore, implications of findings related to indicator calculation and how the findings are similar to other countries will be provided. Finally, recommendation will be given to overcome challenges that have been addressed.

## 6.1 Summary of differences

Comparison has been done between population data at the district level and facility level in the Zambian health system. The district level comparison was done between three sources: population data from CSO, PATH, and DHO. One interesting finding is that PATH and DHO claimed that the district population data was coming from CSO but the population figures ended up different. The comparisons between six districts within Copperbelt province show that there are no extreme differences, which range from only 1 to 63 individuals. On the contrary, four out of five districts within Lusaka province have large differences because they were affected by district splitting.

The facility level comparisons was done between two sources: PATH and DHO, and the differences are represented in percentage. It is interesting to note that there is no single health facility that has the same catchment population figures. The result of the study indicates that the least difference is at 0.11% and the largest difference is at 1973.27%.

While PATH and the DHOs derive the district population from one source which is CSO, they use different methods for estimating facility catchment population. Each facility gets a certain proportion of district population. PATH uses average OPD attendance of each health facility as a proxy to gauge how many people visiting the facility. They then use that as parameters to find appropriate proportion of district population to assign to the facility. The DHOs determine a certain percentage of district population for each health facility.

Looking at the distribution of percentage differences shown in Section 5.5.1, though it was done by a rather arbitrary method, it could show us that most facilities have differences between 0-30 percent.

## 6.2 Reasons for the differences

There are several explanations as to why the population data, at the district level and the facility level are different. The reasons are related to the creation of new districts, different lists of health facilities, and different parameters.

After the census in 2010, the government of Zambia has created several new districts. The problem arises when CSO does not provide the new projections for those new districts and for the old districts that are affected by the splitting. Since the DHOs explained that the new district population they used was obtained from CSO, it is assumed that CSO has estimated new population, however they have not made an updated version of the document *Population and Demographic Projection 2011-2035*. This document is most likely the main and official source of population data in Zambia since it contains the result of the latest census. Since there is not an updated version of this, PATH and probably other organizations tend to calculate their own population estimates for new districts and the affected old districts. Because CSO is recognized as the official source of population statistics in Zambia, it is important that there is a clear procedure of how to derive population data from them. The large differences affected by new district creations are demonstrated in district population comparison within Lusaka province. There are four districts (Chongwe, Rufunsa, Kafue, and Chilanga) that have large discrepancy between DHO and PATH.

Furthermore, another reason is that the DHOs and PATH do not have the same lists of health facilities. The different numbers of health facilities that exist within a district, affects how the district population is divided to each facility. In 11 districts compared, PATH has 344 health facilities, while the DHOs has 244. Since PATH has a longer list, naturally the estimates are lower on average, because the district population is divided to more health facilities.

The third reason is related to the method used to estimate catchment population. The idea of the method is to divide district population to each facility within the district. PATH and the DHOs have different parameters to assign a certain proportion of district population to each facility. PATH uses OPD attendance as proxy to see how many people attend a health facility. Using a proxy has proved useful, as described in an example in Chapter 3 from a research conducted in England (Gandy, 1979) where the number of deaths and discharges in a hospital were used as a proxy, to measure how many people that are treated in that hospital. A proxy can be used in place of a variable that cannot be measured or is difficult to measure. In this research, the exact number of target population is the variable that is difficult to measure, and therefore PATH uses OPD attendance as a proxy. In order

for a variable to be a suitable proxy, it has to have a correlation with the variable of interest. OPD attendance is deemed as a good proxy, because it indicates how many patients visit a facility regardless of which services they use.

One of the challenges with using proxy is to find the proxy that all the facilities have. PATH mentioned that there are some health facilities who do not have a comprehensive or complete OPD attendance, and therefore the solution was to use other similar facility's proxy. A proxy should represent a more complete picture of the services given and at the same time it should be something that all health facilities share.

Another challenge with using a proxy is that it portrays the number of people who actually use the health facility instead of the number of people who should be using it from a geographical or ease of access point of view. If a clinic provides poor services (for reasons such as less medicines, inadequate physicians, etc.) people would tend to travel further for another clinic that provides better services. As a result, the former clinic will have a smaller catchment population. This clinic will actually get better indicators which hides the fact that it is not operating well. For example, Clinic A should be serving 250 pregnant women. Using a proxy, the estimated number of pregnant women visiting this clinic is 100. The indicators are affected when calculated using 100 as denominator, so for instance, 50/100 is better indicator to see how many pregnant women have received care than 50/250. So using a proxy can hide some of the information for such as figuring out which health facilities struggle to provide good services.

Furthermore, using a proxy also does not work well for hospitals which usually have overlapping catchment populations with the other smaller facilities. A hospital may cover the same population as Clinic A, B, and C when it provides other health services. However this is not always the case since a hospital sometimes also covers the same services as the clinics.

## 6.3 Implications

As mentioned, the findings from comparisons of district and facility levels, were not very encouraging. The fact that there are different sources of catchment population will naturally raise the question of which data is more reliable. Having two different population figures, has an impact when calculating indicators. As described in Section 3.1.1.4, population data is important as denominator for various health indicators. When there are two different sets of population data as denominators, the calculation of health indicators yield two different results. Consequently, the indicators cannot be deemed reliable.

The type of population data needed for denominators also varies depending on which health indicator is calculated. Some health indicators need population data that is age specific, and other indicators need total population. While the DHOs provide health facilities with catchment population disaggregated to specific age and gender, the problem lies with

the total catchment population that is not reliable to begin with. PATH leads some vertical programs in the Zambian health sector and uses their own estimation of catchment population. Some of the programs are run through health facilities. It is possible that the health facilities would have two different catchment population figures. One figure from DHO, and another from PATH, specifically for programs led by PATH. The health facilities then calculate health indicators requested by DHO and PATH separately. The implication of this is, first, there will be too much effort done by health facility staff having to use two denominators, and second, the indicators reported are calculated from different sources. It would become a difficult task for health managers to analyze indicators and find both sources reliable.

## 6.4 Comparison with other countries

This study has been able to demonstrate that the challenges related to population data is not unique to the Zambian health sector. The findings are similar to previous studies which suggested that while census is the primary source of population data, it tends to provide unreliable figures since they are not updated frequently (Olaussen, 2017, Asah, Nielsen, and Sæbø, 2017). The same finding was found in research conducted in Cameroon (Asah, Nielsen, and Sæbø, 2017) which shows that because population data is not available for administrative units below district level, facility managers together with district managers are forced to calculate the facility catchment population by themselves. The challenges arise when the staff are lacking numeracy skills to perform the calculations. Additionally, the method used for estimating the catchment population does not come from staff whom normally performs such statistics on population data or experts in population data. However, it is possible that the DHOs are working together with other staff from a higher level of the health system to come up with the method of estimating catchment population, but the DHO staff are the ones who conduct the calculations every year. Contrary to the research in Cameroon, this study demonstrates that the health facilities are not involved in the calculation process.

The study in Tanzania (Olaussen, 2017) shows that the health facilities have been using outdated target population data. The inaccurate population data has a negative impact on vaccine forecasting. Since the population figures used in Zambia are also the result of a census from 2010, that has not been updated yet, the problem with vaccine forecasting is also likely to happen in the health facilities. It could be difficult to know how many children belong to a catchment population, and therefore it is also difficult to forecast how many vaccines are needed.

As Sahay, Sundararaman, and Braa (2017) suggested, a certain margin of error will always be found in the denominator figures. Since census is not performed frequently,

denominators will always be in the form of estimates. The percentage of certain population groups are also an estimate. For example, expected pregnancies is typically calculated as 4% of catchment population (Sahay, Sundararaman, and Braa, 2017). When the DHOs and PATH assign proportion or percentage of district population to each facility, it is also in the form of estimates. If different proxies was used by PATH to determine the percentage each facility gets, the catchment population derived could be different.

A different way of estimating catchment population is by estimating the catchment area of a facility first, as described in Section 3.2.2. The DHOs in Zambia are not using this method. Using GIS method would require better base map that shows the lowest administrative unit boundaries so that the estimation of catchment areas (such as wards surrounding a facility) will become accurate. Even if the catchment areas can be drawn using GIS, assigning population to them will still be difficult because the population data for the lowest administrative unit itself is not available.

## 6.5 Recommendations

This section provides recommendations to improve to population data in Zambia.

Firstly, the Zambian health sector should have a master list of health facilities in the country. Since there are many NGOs and other organizations who work in the Zambian health sector, it is important that they have the same list of health facilities so that they can track progress and performance, in addition to prevent different estimations of catchment population. According to WHO (2012), few countries have up-to-date information on the availability of health services in both private and public sector. Many countries have a list of health facilities with different ways for naming and identifying the health facilities. The aim is to establish a Master Facility List (MFL) (WHO, 2012) to maintain one single list which allows uniquely identifying health facilities and comparing information across data sources and across time for individual facilities. MFL is "*a complete listing of health facilities in a country, both public and private, and is comprised of a set administrative and of identifying information for each facility (signature domain) and basic information on the service capacity of each facility (service domain)"* (WHO, 2012). Currently, most of the health facilities in the Zambian health sector have unique identifying numbers, but still have varying norms for naming. Developing an MFL will give a multitude of advantages such as data harmonization that allows contrasting and comparing data across time, good administration with knowledge of the type and location of health resources, and provide health information for the public, transparency, and efficient access to the facility data to the Ministry of Health and partners (WHO, 2012).

Secondly, there should not be different methods for estimating catchment population in the Zambian health sector. The population data for health sector currently is fragmented. There are different sources and each source uses its own method. As mentioned, this has a

negative impact for when calculating health indicators because many denominators use population-based data. This leaves us doubting which is correct in case of contradictions. The aim should be to maintain a standardized method for estimating facility catchment population. The necessary institutional arrangements should be in place in order to secure sufficient commitment to develop the standardized method. Population data based on administrative units exist in different system – CSO's system – while population data for health sector exists in HIS maintained by the Ministry of Health. Since CSO is responsible for making projections of population data for administrative units, it is important that the Ministry of Health has strong inter-sectoral link with CSO to encourage up-to-date population data supply for the health system. CSO could be the one that holds the standardized method since the office have staff that are specialized in population data and statistics. This way, PATH, other organizations, and public would know that there is one established source of population data along with catchment population estimation method, and the method used should be uniform nation-wide.

Additionally, the use of DHIS2 should be improved. The population data for health sector should be put into the DHIS2 to allow a more effective aggregation, indicator calculation, and sharing between users.

Thirdly, there should be efforts put into improving the census and CRVS. As described in Section 3.5, census is among the most complex and massive exercises a nation undertakes. It requires immense budget, time, and human resources. However, census is important to provide the numerical profile at small areas, regional, national levels, in addition to other characteristics such as education, occupation, housing, economic activity, which support evidence-based decision-making at all levels (United Nations, 2008). The task of improving census can be problematic as this is probably not the most prioritized focus in Zambia. As a result, allocating budget can be difficult too. Conducting census more frequently than once every ten years may not be probable, however the government of Zambia could improve the other aspects such as hiring more experts and preparing the budget and human resources better ahead. Since costs are the focus of attention and challenge, it is critical that the census plan and budget are presented to the government with adequate lead time to ensure the availability of sufficient resources from national budgets. Therefore, a commitment to strengthening the census should be established.

In regards to CRVS, the principle is the same. Budgeting and planning should be at the level sufficient to support effective strengthening. There should be a commitment from the government to establish well-functioning civil registration systems with accurate attribution of deaths. In Zambia, there are births and deaths that are not registered. The national identification systems are also deficient. The government of Zambia should increase the political commitment towards building sufficient CRVS. It may take long time and massive resources but it will pay for itself many times over by improving the universal

health coverage and increasing the efficiency of resource allocation in the long run. Two key recommendations related to improving CRVS could be:

- Systems for recording vital events: conduct significant steps to establish a system for registration of births, deaths, and causes of deaths.
- Technology innovation: integrate the use of ICTs in national health information system and infrastructure.

Building a good CRVS system will take a long time. As short-term recommendations, population projections should be updated frequently and calculated down to the lowest administrative unit, and methods for estimating catchment population should be improved going forward.

# Chapter 7

# Conclusion

This chapter sums up the findings and discussion in relation to the research questions introduced in Chapter 1. The study was conducted in Zambia and looks at challenges of estimating population data for health information system. Suggestions for further research is also provided in the last section.

## 7.1 Findings and contributions

The first research questions is *how are different sets of population data in Zambia derived?*

It was found that population data for administrative units in Zambia is provided through the censuses that are conducted every ten years. The CSO is the official government organization who is responsible to plan and conduct the census, as well as disseminate the information.

Zambian health sector requires population data for all levels in health system. For national, provincial, and district level, the population data is derived directly from CSO who has provided annual projections for these levels until 2035 based on the last census in 2010. CSO estimates annual growth rates for each administrative unit and up until now, the population projections are based on that. Overall, there is no issue in obtaining the population data for these levels except for the districts that are affected by the creation of new districts. Some of new districts are created by cutting across multiple districts and therefore the populations of old districts were altered. It was found that CSO has not updated the population for these districts. There are no new population figures published by CSO in document *Population and Demographic Projections 2011-2035.* The DHOs however, stated that the district population they obtained was from CSO and thus it could be assumed that CSO may have calculated new population but did not make it available for public. So, population data sets for national, provincial, and district level in health system are derived from one source which is CSO.

This is not the case with population data for the facility level. Taking a closer look at the absence of population data for administrative units below district, two sources of estimates for health facility catchment population were identified, namely DHO and PATH. The findings show that the catchment populations were derived from different methods. The

DHOs and PATH both divide the district population to the facilities within the district. The DHOs estimates a certain percentage each facility gets from district population. PATH estimates a certain proportion each facility gets from district by using average OPD attendance as a proxy to see how many people actually use a facility. Low number of OPD attendance may result in small catchment population. The finding also shows that the health facilities are not involved in the estimation process since it is done by the DHO staff.

Overall, there were 3 sources (CSO, DHO, and PATH) that were looked into regarding population data estimation. This also indicates that population data in Zambian health sector is fragmented. Population data exists in different systems and estimated by multiple sources.

The second research question is *how do population figures from different sources compare to each other?*

The comparison of district population was done between the 3 sources and shows that large differences only exist between districts that went through district splitting. Since CSO has not provided the updated districts population for public, it complicates the estimation. It was found that PATH estimated these new districts population using their own method. As a result, there is no consensus of the new population for these newly divided districts and this leads to big discrepancies between the DHOs and PATH's population figures.

The comparison of facility catchment population was done between 2 sources, the DHOs and PATH, and shows that the differences vary from 0.11% and 1973.27%. These findings do not show promising result since there is no single health facility that has the same population figures. Many differences are tolerable since they are low, such as 0.11%. However, extreme differences are concerning since those may leave us in doubt to know which catchment population is correct.

This thesis contributes by discussing how the differences in catchment population affect health information system and by providing recommendations to improve to population data in Zambia. The implication of having different catchment populations is that it could complicate the calculation of health indicators since using two different population figures as denominator gives different result. PATH understandably would like to use their own estimations of catchment population for calculating indicators for their own programs, and the DHOs are required to use their estimations for indicators such as in HMIS. This could confuse health facility staff or district health program managers when looking at the indicators because they are not comparable and they may find them difficult to trust.

There exist different methods of estimating catchment population, but it is recommended that Zambian health sector have one standardized method. This is to prevent multiple estimations of catchment population to occur in HIS. This way, health facilities

and other organizations may refer to only one source, making the estimations uniform. Important recommendation to note, is to create a Master Facility List to prevent duplication and omission of facilities in the lists. The goal should be to maintain one single list from which all other lists can be extracted or linked, such as other core health system data for financing and human resources. The long-term recommendations relate to improving census and CRVS systems. Since costs are the focus of attention, it is important to plan the census with the adequate time and budget. The government of Zambia should also focus on improving systems for recording births and deaths, as well as providing unique ID for the citizens. This will take a long time, and in the meantime, better methods for estimating population figures will need to improve. CSO should also provide up-to-date projections in a timely manner.

## 7.2 Further research

The thoughts about future work are mostly the result of thoughts about what I would have researched if there had been more time or access.

There are questions related to the exact method the DHOs use to calculate the percentage each facility gets from district population. The documents sent by the DHOs show the percentages but the method has not been explored. This could have given a complete comparison between two methods by PATH and the DHOs, making the reasoning of differences more comprehensive.

It would be fruitful to discuss this topic in a more detail with CSO to improve understanding of how they share the data to the health sector. Additionally, a further research can be conducted in health facilities to examine the challenges they face when calculating health indicators regularly using different catchment populations.

Furthermore, it would also be advantageous to explore different methods used in other developing countries in relation to calculating catchment population, since the study indicates that these findings are not particular to Zambia. The findings from different countries will create important insights, giving the opportunity to explore a better method which later can inform the standardization process. Comparison of different methods would generate valuable understanding for the countries who face similar challenges and aim the same goals.

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# APPENDIX A

Appendix A contains the complete list of comparison of facility level catchment population between the DHOs and PATH.

| No | District | Facility | Type of Facility | Population | | Difference (%) |
|---|---|---|---|---|---|---|
| | | | | DHO | PATH | |
| **Lusaka Province** | | | | | | |
| 1 | Lusaka | Airport | Urban Health Centre | 6991 | 4,644 | 50.54 |
| 2 | Lusaka | Bauleni | Urban Health Centre | 88,541 | 26,846 | 229.81 |
| 3 | Lusaka | Cancer Diseases | Hospital | | 6,821 | |
| 4 | Lusaka | Chainama Hill | Hospital | | 6,821 | |
| 5 | Lusaka | Chainama | Urban Health Centre | | 202,634 | |
| 6 | Lusaka | Chainda South | Clinic | | 5,035 | |
| 7 | Lusaka | Chainda | Urban Health Centre | 50,910 | 41,355 | 23.10 |
| 8 | Lusaka | Chaisa | Urban Health Centre | 77,473 | 77,956 | 0.62 |
| 9 | Lusaka | Chawama | Urban Health Centre | 137,238 | 190,229 | 27.86 |
| 10 | Lusaka | Chazanga | Urban Health Centre | 44,271 | 38,794 | 14.12 |
| 11 | Lusaka | Chetone | Urban Health Centre | 117,317 | 59,515 | 97.12 |
| 12 | Lusaka | Chilenje | Urban Health Centre | 110,676 | 113,750 | 2.70 |
| 13 | Lusaka | Chipata | Urban Health Centre | 163,114 | 213,879 | 23.74 |
| 14 | Lusaka | Chunga Sub-Centre | Health Post | | 42,537 | |
| 15 | Lusaka | Civic Centre | Urban Health Centre | 44,274 | 49,499 | 10.56 |
| 16 | Lusaka | Evelyn Hone College | Health Post | | 42,537 | |
| 17 | Lusaka | Freedom | Urban Health Centre | 11,651 | 15,125 | 22.97 |
| 18 | Lusaka | George | Urban Health Centre | 172,435 | 107,610 | 60.24 |
| 19 | Lusaka | Kabwata | Urban Health Centre | 107,189 | 52,680 | 103.47 |
| 20 | Lusaka | Kalingalinga | Urban Health Centre | 90,878 | 61,901 | 46.81 |
| 21 | Lusaka | Kamwala | Urban Health Centre | 130,491 | 95,857 | 36.13 |
| 22 | Lusaka | Kanyama | Urban Health Centre | 186,416 | 190,674 | 2.23 |
| 23 | Lusaka | Kanyama West | Health Post | | 42,537 | |
| 24 | Lusaka | Kaunda Square | Urban Health Centre | 53,595 | 24,750 | 116.55 |
| 25 | Lusaka | Levy Mwanawasa General | Hospital | | 6,821 | |
| 26 | Lusaka | Lilayi | Urban Health Centre | 18,642 | 21,175 | 11.96 |
| 27 | Lusaka | Lusaka Central Prison | Urban Health Centre | 11,651 | 12,237 | 4.79 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 28 | Lusaka | Makeni | Urban Health Centre | 51,264 | 55,936 | 8.35 |
| 29 | Lusaka | Mandevu | Urban Health Centre | 95,538 | 19,533 | 389.11 |
| 30 | Lusaka | Matero Main | Urban Health Centre | 114,180 | 25,608 | 345.88 |
| 31 | Lusaka | Matero Reference | Urban Health Centre | 132,821 | 144,760 | 8.25 |
| 32 | Lusaka | Ministry Of Health Staff | Health Centre | | 26,109 | |
| 33 | Lusaka | MKP/TMS | | | 11,315 | |
| 34 | Lusaka | Mtendere | Urban Health Centre | 109,519 | 102,029 | 7.34 |
| 35 | Lusaka | Ng'ombe | Urban Health Centre | 55,925 | 30,388 | 84.04 |
| 36 | Lusaka | Nipa | Health Post | | 42,537 | |
| 37 | Lusaka | Railway | Urban Health Centre | | 17,908 | |
| 38 | Lusaka | Railway-k | Urban Health Centre | 81,557 | 24,639 | 231.01 |
| 39 | Lusaka | Sikanze Police | Hospital | | 6,821 | |
| 40 | Lusaka | St Agness | Urban Health Centre | 13,981 | 18,066 | 22.61 |
| 41 | Lusaka | State House | Clinic | 11,651 | 20,606 | 43.46 |
| 42 | Lusaka | State Lodge | Urban Health Centre | 11,651 | 22,904 | 49.13 |
| 43 | Lusaka | University Teaching Hospital | Hospital | | 6,821 | |
| | | | | | | |
| 44 | Rufunsa | Bunda Bunda | | 2,668 | | |
| 45 | Rufunsa | Chifundo | Rural Health Centre | 3,107 | 2,680 | 15.93 |
| 46 | Rufunsa | Chimusanya | Health Post | 5,290 | 2,913 | 81.60 |
| 47 | Rufunsa | Chinyunyu | Rural Health Centre | 4,475 | 6,512 | 31.28 |
| 48 | Rufunsa | Chitemalesa | Health Post | 4,724 | 4,957 | 4.70 |
| 49 | Rufunsa | Chiyota | Health Post | 2,237 | 1,643 | 36.15 |
| 50 | Rufunsa | Kankumba | Rural Health Centre | 3,835 | 8,082 | 52.55 |
| 51 | Rufunsa | Kanyongoloka | | 1,918 | | |
| 52 | Rufunsa | Kazemba | | 1,494 | | |
| 53 | Rufunsa | Luangwa Bridge | Health Post | 2,602 | 3,409 | 23.67 |
| 54 | Rufunsa | Lukwipa | Rural Health Centre | 4,293 | 6,046 | 28.99 |
| 55 | Rufunsa | Mpanshya | Hospital Affiliated Health Centre | 4,102 | 10,753 | 61.85 |
| 56 | Rufunsa | Mpanshya Mission | Hospital | | 5,444 | |
| 57 | Rufunsa | Mulamba | Health Post | 3,196 | 4,735 | 32.50 |
| 58 | Rufunsa | Mwachilele | Health Post | 2,229 | 3,802 | 41.37 |
| 59 | Rufunsa | Namanongo | Health Post | 3,196 | 3,832 | 16.60 |
| 60 | Rufunsa | Nyangwena | Rural Health Centre | 3,102 | 7,345 | 57.77 |
| 61 | Rufunsa | Rufunsa | Rural Health Centre | 5,718 | 5,119 | 11.70 |
| 62 | Rufunsa | Rutech | | 2,237 | | |
| 63 | Rufunsa | Shikabeta | Rural Health Centre | 2,220 | 1,864 | 19.10 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 64 | Rufunsa | Tengama | | 1,278 | | |
| | | | | | | |
| 65 | Chilanga | Balmora | | 965 | 1,526 | 36.76 |
| 66 | Chilanga | Chilanga | Urban Health Centre | 20,667 | 16,335 | 26.52 |
| 67 | Chilanga | Kazimva | Rural Health Centre | 34,445 | 7,965 | 332.45 |
| 68 | Chilanga | Kris Katumba | Health Post | 20,667 | 14,323 | 44.29 |
| 69 | Chilanga | Makeni_Konga | Rural Health Centre | 22,045 | 6,956 | 216.92 |
| 70 | Chilanga | Mt Eugenia | Hospital | | 10,023 | |
| 71 | Chilanga | Mt Makulu | Urban Health Centre | 24,800 | 21,708 | 14.24 |
| 72 | Chilanga | Mwembeshi Prisons | Health Post | | 1,676 | |
| 73 | Chilanga | Mwembeshi | Rural Health Centre | 14,191 | 11,926 | 18.99 |
| 74 | Chilanga | Paramilitary | Health Post | | 6,607 | |
| 75 | Chilanga | ZA-Apollo | Rural Health Centre | | 7,023 | |
| 76 | Chilanga | Zambia Army Apollo | Rural Health Centre | | 9,624 | |
| 77 | Chilanga | Zambia Helpers Society | Hospital | | 10,023 | |
| 78 | Chilanga | ZNS-BB | Health Post | | 3,343 | |
| 79 | Chilanga | ZNS-LDB | Health Post | | 6,721 | |
| 80 | Chilanga | ZNS-Safari | Health Post | | 6,110 | |
| 81 | Chilanga | ZNS-Sopelo | Health Post | | 2,492 | |
| | | | | | | |
| 82 | Chongwe | Chainda | Rural Health Centre | 5,647 | 7,056 | 19.97 |
| 83 | Chongwe | Chalimbana | Rural Health Centre | 17,769 | 6,002 | 196.05 |
| 84 | Chongwe | Chaminuka | Health Post | | 1,580 | |
| 85 | Chongwe | Chikumbi | Health Post | 2,113 | 2,925 | 27.76 |
| 86 | Chongwe | Chongwe District | Hospital | | 8,927 | |
| 87 | Chongwe | Chongwe Referral | Rural Health Centre | 11,140 | 14,611 | 23.76 |
| 88 | Chongwe | Ellensdale Farm | Health Post | 6,768 | 4,108 | 64.75 |
| 89 | Chongwe | Kabeleka | Health Post | 13,573 | 4,796 | 183.01 |
| 90 | Chongwe | Kampekete | Rural Health Centre | 3,285 | 3,424 | 4.06 |
| 91 | Chongwe | Kanakantapa | Rural Health Centre | 4,342 | 2,875 | 51.03 |
| 92 | Chongwe | Kapete | Health Post | 1,614 | 1,786 | 9.63 |
| 93 | Chongwe | Kasenga | Health Post | 14,265 | 2,693 | 429.71 |
| 94 | Chongwe | Kasisi | Rural Health Centre | 3,285 | 3,006 | 9.28 |
| 95 | Chongwe | Katoba | Rural Health Centre | 2,449 | 7,320 | 66.54 |
| 96 | Chongwe | Lwiimba | Rural Health Centre | 3,042 | 5,813 | 47.67 |
| 97 | Chongwe | Mikango | Rural Health Centre | 1,448 | 7,546 | 80.81 |
| 98 | Chongwe | Mpango | Rural Health Centre | 2,894 | 3,897 | 25.74 |
| 99 | Chongwe | Msangila | Rural Health Centre | | 5,734 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 100 | Chongwe | Mutamino | Health Post | 8,617 | 3,418 | 152.11 |
| 101 | Chongwe | Mwalumina | Rural Health Centre | 9,545 | 5,406 | 76.56 |
| 102 | Chongwe | Nchute | Health Post | 3,180 | 3,043 | 4.50 |
| 103 | Chongwe | Ngwerere | Health Post | 7,039 | 6,844 | 2.85 |
| 104 | Chongwe | Ngwerere Main | Rural Health Centre | 2,440 | 7,564 | 67.74 |
| 105 | Chongwe | Palabana | Rural Health Centre | 8,867 | 4,499 | 97.09 |
| 106 | Chongwe | Shiyala | Health Post | 6,244 | 2,786 | 124.12 |
| 107 | Chongwe | Water Fal | Rural Health Centre | 2,499 | 5,785 | 56.80 |
| 108 | Chongwe | ZAF 71 | Rural Health Centre | 2,635 | 3,509 | 24.91 |
| 109 | Chongwe | ZAF Base | Rural Health Centre | 7,426 | 8,050 | 7.75 |
| 110 | Chongwe | Zasti | Rural Health Centre | 2,619 | 2,041 | 28.32 |
| 111 | Chongwe | ZNS Airport | Health Post | 9,897 | 3,088 | 220.50 |
| 112 | Chongwe | ZNS Chongwe | Clinic | 3,572 | 7,485 | 52.28 |
| 113 | Chongwe | Mulalika | | 4,613 | | |
| | | | | | | |
| 114 | Kafue | Chanyanya | Rural Health Centre | 10,876 | 7,171 | 51.67 |
| 115 | Kafue | Chiawa | Rural Health Centre | 4,661 | 5,438 | 14.29 |
| 116 | Kafue | Chikoka | Health Post | 3,107 | 3,747 | 17.08 |
| 117 | Kafue | Chikupi | Rural Health Centre | 7,768 | 8,372 | 7.21 |
| 118 | Kafue | Chipapa | Rural Health Centre | 9,322 | 5,211 | 78.89 |
| 119 | Kafue | Chisankane | Rural Health Centre | 9,322 | 3,746 | 148.85 |
| 120 | Kafue | Estate | Urban Health Centre | 29,520 | 22,405 | 31.76 |
| 121 | Kafue | Kabweza | Health Post | 3,107 | 3,747 | 17.08 |
| 122 | Kafue | Kafue District | Hospital | 130,510 | 15,170 | 760.32 |
| 123 | Kafue | Kafue Mission | Rural Health Centre | 9,322 | 14,705 | 36.61 |
| 124 | Kafue | Kafue Mission/ ZNS | Rural Health Centre | | 6,945 | |
| 125 | Kafue | Kambale | Rural Health Centre | 6,215 | 3,600 | 72.64 |
| 126 | Kafue | Mugurameno | Health Post | 3,107 | 2,437 | 27.49 |
| 127 | Kafue | Nangongwe OPD/Maternity | Health Centre | 21,752 | 22,420 | 2.98 |
| 128 | Kafue | Railway GRZ | Urban Health Centre | 23,305 | 15,559 | 49.78 |
| 129 | Kafue | Shimabala | Health Post | 7,768 | 4,351 | 78.53 |
| 130 | Kafue | ZNS Kafue | Health Post | 4,661 | 3,747 | 24.39 |
| | | | | | | |
| **Copperbelt Province** | | | | | | |
| 131 | Masaiti | Chikumbi | Rural Health Centre | 4,931 | 5,819 | 15.26 |
| 132 | Masaiti | Chilese | Rural Health Centre | 8,218 | 5,614 | 46.38 |

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|---|---|---|---|---|---|---|
| 133 | Masaiti | Chinondo | Rural Health Centre | 3,522 | 4,233 | 16.80 |
| 134 | Masaiti | Chiwala | Health Post | 2,348 | 8,082 | 70.95 |
| 135 | Masaiti | Chondwe | Rural Health Centre | 4,696 | 2,205 | 112.97 |
| 136 | Masaiti | Fiwale | Rural Health Centre | 11,739 | 10,591 | 10.84 |
| 137 | Masaiti | Kafulafuta | Rural Health Centre | 4,813 | 5,990 | 19.65 |
| 138 | Masaiti | Kafulafuta GRZ | Rural Health Centre | 7,044 | 5,822 | 20.99 |
| 139 | Masaiti | Kaloko | Rural Health Centre | 7,044 | 7,052 | 0.11 |
| 140 | Masaiti | Kambowa | Rural Health Centre | 4,696 | 3,288 | 42.82 |
| 141 | Masaiti | Kamifungo | Health Post | 2,348 | 1,815 | 29.37 |
| 142 | Masaiti | Kashitu | Rural Health Centre | 7,044 | 9,473 | 25.64 |
| 143 | Masaiti | Lupiya | Health Post | 2,594 | 2,849 | 8.95 |
| 144 | Masaiti | Masaiti Boma | Rural Health Centre | 2,829 | 7,645 | 63.00 |
| 145 | Masaiti | Masaiti Council | Rural Health Centre | 2,935 | 4,807 | 38.94 |
| 146 | Masaiti | Michinka | Health Post | 2,348 | 2,393 | 1.88 |
| 147 | Masaiti | Miengwe | Rural Health Centre | 7,044 | 3,157 | 123.12 |
| 148 | Masaiti | Mishikishi | Rural Health Centre | 8,218 | 9,131 | 10.00 |
| 149 | Masaiti | Mupapa | Rural Health Centre | 6,163 | 5,555 | 10.95 |
| 150 | Masaiti | Mutaba | Rural Health Centre | 7,044 | 6,892 | 2.21 |
| 151 | Masaiti | Njelemani | Rural Health Centre | 5,870 | 4,981 | 17.85 |
| 152 | Masaiti | Mukolwe | | 2,348 | | |
| 153 | Masaiti | Bangwe | | 1,620 | | |
| | | | | | | |
| 154 | Chingola | Kabundi East | Urban Health Centre | 47,966 | 20,440 | 134.67 |
| 155 | Chingola | Chawama | Urban Health Centre | 39,972 | 23,358 | 71.13 |
| 156 | Chingola | Chingola Municipal Council | Urban Health Centre | 10,659 | 18,926 | 43.68 |
| 157 | Chingola | Chiwempala | Urban Health Centre | 34,642 | 22,723 | 52.45 |
| 158 | Chingola | Ipafu | Rural Health Centre | 10,659 | 2,157 | 394.16 |
| 159 | Chingola | Kalilo | Rural Health Centre | 7,994 | 4,684 | 70.67 |
| 160 | Chingola | Kasompe | Urban Health Centre | 23,983 | 19,024 | 26.07 |
| 161 | Chingola | Lulamba | Urban Health Centre | 13,324 | 5,466 | 143.76 |
| 162 | Chingola | Muchinshi | Rural Health Centre | 13,324 | 10,631 | 25.33 |
| 163 | Chingola | Musenga | Health Post | | 3,170 | |
| 164 | Chingola | Mutenda | Rural Health Centre | 10,659 | 10,006 | 6.53 |
| 165 | Chingola | Nchanga | Urban Health Centre | 7,994 | 16,844 | 52.54 |
| 166 | Chingola | Nchanga I | Urban Health Centre | 18,653 | 34,972 | 46.66 |
| 167 | Chingola | Nchanga II | Urban Health Centre | | 18,926 | |
| 168 | Chingola | Nchanga III | Urban Health Centre | 26,648 | 9,552 | 178.98 |
| 169 | Chingola | Nchanga North | Hospital Affiliated Health Centre | | 13,762 | |

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|---|---|---|---|---|---|---|
| 170 | Chingola | Nchanga North Referral | Hospital | | 12,619 | |
| 171 | Chingola | Nchanga South | Hospital Affiliated Health Centre | | 13,762 | |
| 172 | Chingola | Nchanga South Referral | Hospital | | 5,455 | |
| | | | | | | |
| 173 | Mufulira | 14 Miles | Health Post | 2,721 | 3,094 | 12.06 |
| 174 | Mufulira | Buteko | Urban Health Centre | 8,607 | 2,847 | 202.32 |
| 175 | Mufulira | Butondo C | Urban Health Centre | 4,775 | 4,635 | 3.02 |
| 176 | Mufulira | Central Dressings | Health Post | | 17,578 | |
| 177 | Mufulira | Chibolya | Urban Health Centre | 11,578 | 6,544 | 76.93 |
| 178 | Mufulira | Kafironda | Health Post | 1,933 | 2,733 | 29.27 |
| 179 | Mufulira | Kamuchanga | Hospital Affiliated Health Centre | 17,178 | 8,519 | 101.64 |
| 180 | Mufulira | Kamuchanga District | Hospital | | 3,536 | |
| 181 | Mufulira | Kamuchanga | Urban Health Centre | 11,045 | 5,138 | 114.97 |
| 182 | Mufulira | Kansuswa | Rural Health Centre | 6,336 | 5,575 | 13.65 |
| 183 | Mufulira | Kawama West | Health Post | 7,115 | 5,306 | 34.09 |
| 184 | Mufulira | Luansobe | Rural Health Centre | 9,106 | 6,938 | 31.25 |
| 185 | Mufulira | Malcolm Watson | Hospital Affiliated Health Centre | 3,192 | 8,519 | 62.53 |
| 186 | Mufulira | Malcolm Watson | Hospital | | 6,076 | |
| 187 | Mufulira | Mokambo | Rural Health Centre | 6,421 | 3,145 | 104.17 |
| 188 | Mufulira | Mufulira Clinic 1 | Urban Health Centre | 11,918 | 5,974 | 99.50 |
| 189 | Mufulira | Mufulira Clinic 2 | Urban Health Centre | 9,279 | 5,665 | 63.80 |
| 190 | Mufulira | Mufulira Clinic 3 | Urban Health Centre | 9,783 | 5,808 | 68.44 |
| 191 | Mufulira | Mufulira Clinic 4 | Urban Health Centre | | 5,268 | |
| 192 | Mufulira | Mufulira Clinic 5 | Urban Health Centre | 17,887 | 5,850 | 205.76 |
| 193 | Mufulira | Mufulira Clinic 6 | Urban Health Centre | 8,353 | 8,029 | 4.04 |
| 194 | Mufulira | Mufulira Clinic 7 | Urban Health Centre | 4,218 | 2,503 | 68.52 |
| 195 | Mufulira | Mufulira Clinic 8 | Urban Health Centre | | 5,268 | |
| 196 | Mufulira | Mufulira Clinic 9 | Urban Health Centre | 3,696 | 2,083 | 77.44 |
| 197 | Mufulira | Mufulira Prisons | Health Post | | 1,008 | |
| 198 | Mufulira | Mufulira Teachers College | Health Post | | 2,653 | |
| 199 | Mufulira | Mufulira West | Health Post | | 1,036 | |
| 200 | Mufulira | Mupena | Health Post | 3,605 | 3,005 | 19.97 |
| 201 | Mufulira | Murundu | Rural Health Centre | 10,170 | 8,481 | 19.92 |
| 202 | Mufulira | Mutundu | Rural Health Centre | 2,405 | 1,544 | 55.76 |
| 203 | Mufulira | Ronald Ross | Hospital Affiliated Health Centre | 3,173 | 8,519 | 62.75 |

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| 204 | Mufulira | Ronald Ross | Hospital | | 10,355 | |
| 205 | Mufulira | Taung-Up | Clinic | 5,447 | 6,450 | 15.55 |
| 206 | Mufulira | Twatasha | Urban Health Centre | 8,498 | 8,761 | 3.00 |
| | | | | | | |
| 207 | Luanshya | 73 Independence | Urban Health Centre | 3,467 | 557 | 522.44 |
| 208 | Luanshya | Allessandras | Urban Health Centre | 6,933 | 7,167 | 3.26 |
| 209 | Luanshya | Baluba Shaft | Clinic | 1,733 | 4,739 | 63.43 |
| 210 | Luanshya | Chaisa | Urban Health Centre | 13,867 | 11,153 | 24.33 |
| 211 | Luanshya | Chilabula | Urban Health Centre | 1,733 | 1,457 | 18.94 |
| 212 | Luanshya | Fisenge | Urban Health Centre | 10,400 | 4,782 | 117.48 |
| 213 | Luanshya | Franco | Urban Health Centre | 6,933 | 8,226 | 15.72 |
| 214 | Luanshya | Kafubu Block | Urban Health Centre | 6,933 | 4,541 | 52.68 |
| 215 | Luanshya | Kawama | Urban Health Centre | 6,067 | 5,482 | 10.67 |
| 216 | Luanshya | Luanshya Mine | Hospital | | 4,027 | |
| 217 | Luanshya | Luanshya Private | Hospital | | 6,329 | |
| 218 | Luanshya | Luanshya Spita | Hospital Affiliated Health Centre | | 8,956 | |
| 219 | Luanshya | Main | Urban Health Centre | 13,867 | 9,765 | 42.01 |
| 220 | Luanshya | Malaika | Clinic | 10,400 | 3,177 | 227.35 |
| 221 | Luanshya | Mikomfwa | Health Centre | 19,067 | 16,200 | 17.70 |
| 222 | Luanshya | Mikomfwa | Urban Health Centre | 15,600 | 8,341 | 87.03 |
| 223 | Luanshya | Mpatamatu Section 26 | Urban Health Centre | 19,067 | 8,559 | 122.77 |
| 224 | Luanshya | New Town | Urban Health Centre | 4,333 | 4,422 | 2.01 |
| 225 | Luanshya | Plant and Works | Urban Health Centre | 3,467 | 1,694 | 104.66 |
| 226 | Luanshya | Poleline | Health Post | 3,467 | 5,277 | 34.30 |
| 227 | Luanshya | Roan Antelope | Hospital Affiliated Health Centre | | 8,956 | |
| 228 | Luanshya | Roan Antelope Referral | Hospital | | 4,986 | |
| 229 | Luanshya | Section 23 | Urban Health Centre | 5,200 | 3,607 | 44.16 |
| 230 | Luanshya | Section 5 | Urban Health Centre | | 2,983 | |
| 231 | Luanshya | Shaft 18 | | | 2,553 | |
| 232 | Luanshya | Shaft 28 | | | 2,553 | |
| 233 | Luanshya | Thomson | Hospital Affiliated Health Centre | | 8,956 | |
| 234 | Luanshya | Thomson District | Hospital | | 8,167 | |
| 235 | Luanshya | TVTC | Urban Health Centre | 5,200 | 4,321 | 20.34 |
| 236 | Luanshya | Zamefa | Clinic | 1,733 | 1,402 | 23.61 |
| 237 | Luanshya | Mansansa | Health Post | 1,733 | | |
| 238 | Luanshya | Kasongo | Health Post | 2,600 | | |

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| 239 | Luanshya | Maposa | Health Post | 867 | | |
| 240 | Luanshya | Kapupulu Chawama | | 867 | | |
| 241 | Luanshya | Nkulumashiba | Health Post | 1,733 | | |
| 242 | Luanshya | Kampelembe | Health Post | 867 | | |
| 243 | Luanshya | Section 25 | | 1,733 | | |
| 244 | Luanshya | Section 5 | | 3,467 | | |
| | | | | | | |
| 245 | Kitwe | Beatrice Memorial | Medical Centre | | 3,850 | |
| 246 | Kitwe | Buchi Main | Urban Health Centre | 24,061 | 18,498 | 30.07 |
| 247 | Kitwe | Buchi Small Chest | Urban Health Centre | | 12,522 | |
| 248 | Kitwe | Bulangililo | Urban Health Centre | 29,711 | 18,691 | 58.96 |
| 249 | Kitwe | Carewell | Medical Centre | | 3,236 | |
| 250 | Kitwe | CBU | Urban Health Centre | | 8,951 | |
| 251 | Kitwe | Chamboli J (Mopani) | Urban Health Centre | | 3,981 | |
| 252 | Kitwe | Chavuma | Urban Health Centre | 11,810 | 7,982 | 47.96 |
| 253 | Kitwe | Chilobwe | Rural Health Centre | 5,241 | 760 | 589.61 |
| 254 | Kitwe | Chimwemwe | Urban Health Centre | 53,514 | 18,156 | 194.75 |
| 255 | Kitwe | City Square (Council) | Clinic | | 1,773 | |
| 256 | Kitwe | Community Development College | Health Post | 5,709 | 947 | 502.85 |
| 257 | Kitwe | Company | Urban Health Centre | | 6,088 | |
| 258 | Kitwe | Cosetco | Health Post | 6,309 | 4,820 | 30.89 |
| 259 | Kitwe | Garnatone | Urban Health Centre | 18,667 | 9,743 | 91.59 |
| 260 | Kitwe | Hillview | Medical Centre | | 2,957 | |
| 261 | Kitwe | Ipusukilo | Urban Health Centre | 32,510 | 12,930 | 151.43 |
| 262 | Kitwe | Itimpi | Urban Health Centre | 10,159 | 490 | 1973.27 |
| 263 | Kitwe | Kakolo | Health Post | 8,167 | 2,216 | 268.55 |
| 264 | Kitwe | Kakolo | Rural Health Centre | | 5,903 | |
| 265 | Kitwe | Kamfinsa | Urban Health Centre | 7,815 | 10,205 | 23.42 |
| 266 | Kitwe | Kamitondo | Urban Health Centre | 16,456 | 17,571 | 6.35 |
| 267 | Kitwe | Kawama Kitwe | Urban Health Centre | 43,052 | 30,793 | 39.81 |
| 268 | Kitwe | KCM Nkana | Clinic | | 4,648 | |
| 269 | Kitwe | Kitwe Central | Hospital Affiliated Health Centre | | 11,530 | |
| 270 | Kitwe | Kitwe Central Referral | Hospital | | 43,605 | |
| 271 | Kitwe | Kitwe College of Education | Health Post | 10,368 | 2,933 | 253.49 |
| 272 | Kitwe | Kitwe District Police | Clinic | 16,317 | 3,739 | 336.40 |

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| 273 | Kitwe | Kitwe Vocation Training College | Health Post | | 484 | |
| 274 | Kitwe | Kwacha | Urban Health Centre | 32,147 | 8,610 | 273.37 |
| 275 | Kitwe | Luangwa | Urban Health Centre | 41,450 | 14,225 | 191.39 |
| 276 | Kitwe | MARS | Urban Health Centre | | 12,522 | |
| 277 | Kitwe | Mawlaick (ZCCF Kitwe Camp) | Clinic | | 7,142 | |
| 278 | Kitwe | Mawlaick | Urban Health Centre | 5,866 | 12,522 | 53.15 |
| 279 | Kitwe | MEF | Health Post | | 264 | |
| 280 | Kitwe | Mindolo 1 | Urban Health Centre | 17,812 | 15,426 | 15.47 |
| 281 | Kitwe | Mindolo 2 (Mopani) | Clinic | | 3,229 | |
| 282 | Kitwe | Miseshi | Urban Health Centre | | 20,511 | |
| 283 | Kitwe | Miseshi-Mindolo | Health Post | 15,901 | 14,623 | 8.74 |
| 284 | Kitwe | Mpelembe Secondary School | Health Post | | 3,011 | |
| 285 | Kitwe | Mulenga | Urban Health Centre | 37,995 | 12,560 | 202.51 |
| 286 | Kitwe | Mumana | Urban Health Centre | | 12,522 | |
| 287 | Kitwe | Mwaiseni | Urban Health Centre | 9,603 | 5,349 | 79.53 |
| 288 | Kitwe | Mwekera | Urban Health Centre | 7,687 | 6,621 | 16.10 |
| 289 | Kitwe | Natwange (Mopani) | Clinic | | 558 | |
| 290 | Kitwe | Ndeke | Urban Health Centre | 55,419 | 15,667 | 253.73 |
| 291 | Kitwe | Ndeke Village | Health Centre | 23,500 | 12,157 | 93.30 |
| 292 | Kitwe | New Start (Kitwe) | | | 3,287 | |
| 293 | Kitwe | Nkana | Hospital Affiliated Health Centre | | 11,530 | |
| 294 | Kitwe | Nkana East | Urban Health Centre | | 12,522 | |
| 295 | Kitwe | Occupational | | | 3,287 | |
| 296 | Kitwe | OHMB District | Hospital | | 26,791 | |
| 297 | Kitwe | Progress | Medical Centre | | 7,633 | |
| 298 | Kitwe | Riverside | Urban Health Centre | 32,681 | 9,635 | 239.19 |
| 299 | Kitwe | Sinozam Friendship | Hospital | | 14,733 | |
| 300 | Kitwe | SOS Kitwe | Health Centre | | 2,504 | |
| 301 | Kitwe | Springs of Life | Medical Centre | | 2,373 | |
| 302 | Kitwe | Tinna | Medical Centre | | 2,139 | |
| 303 | Kitwe | Twatasha (Kitwe) | Urban Health Centre | 29,418 | 20,931 | 40.55 |
| 304 | Kitwe | Wusakile D4 (Mopani) | Clinic | | 5,611 | |
| 305 | Kitwe | Wusakile Government | Clinic | | 3,813 | |
| 306 | Kitwe | Wusakile GRZ | Urban Health Centre | 41,765 | 14,523 | 187.58 |
| 307 | Kitwe | Wusakile Mine | Hospital | | 32,269 | |

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| 308 | Kitwe | Wusakile Spita Private | Hospital | | 26,791 | |
| 309 | Kitwe | Zamtan | Urban Health Centre | 10,699 | 5,241 | 104.14 |
| 310 | Kitwe | ZNS Kitwe Camp | Clinic | | 3,011 | |
| 311 | Kitwe | ZNS | Urban Health Centre | 6,859 | 12,522 | 45.22 |
| | | | | | | |
| 312 | Ndola | Kabushi | Urban Health Centre | 27,753 | 12,180 | 127.86 |
| 313 | Ndola | Arthur Davison | Hospital | | 11,038 | |
| 314 | Ndola | Arthur Davison | Hospital Affiliated Health Centre | | 24,185 | |
| 315 | Ndola | Bank of Zambia | Urban Health Centre | | 556 | |
| 316 | Ndola | Chichetekelo | Urban Health Centre | | 10,078 | |
| 317 | Ndola | Chilanga Cement | Urban Health Centre | | 10,078 | |
| 318 | Ndola | Chinan | Urban Health Centre | | 2,422 | |
| 319 | Ndola | Chipokota Mayamba | Urban Health Centre | 52,508 | 22,565 | 132.70 |
| 320 | Ndola | Commando | Urban Health Centre | 5,552 | 8,628 | 35.65 |
| 321 | Ndola | Dola Hill | Urban Health Centre | 9,848 | 9,643 | 2.13 |
| 322 | Ndola | Indeni | Urban Health Centre | | 935 | |
| 323 | Ndola | Itawa | Urban Health Centre | 9,725 | 6,270 | 55.10 |
| 324 | Ndola | Jabulani | Urban Health Centre | | 1,509 | |
| 325 | Ndola | Kalewa Barracks | Urban Health Centre | 9,847 | 17,970 | 45.20 |
| 326 | Ndola | Kaloko | Urban Health Centre | 14,630 | 12,103 | 20.88 |
| 327 | Ndola | Kaniki | Urban Health Centre | 11,111 | 17,619 | 36.94 |
| 328 | Ndola | Kansheshi Prison | Urban Health Centre | 11,415 | 8,065 | 41.54 |
| 329 | Ndola | Kavu | Urban Health Centre | 15,694 | 7,713 | 103.47 |
| 330 | Ndola | Kawama (Ndola) | Urban Health Centre | 21,695 | 14,567 | 48.93 |
| 331 | Ndola | Kopa | Urban Health Centre | | 2,950 | |
| 332 | Ndola | Lubuto | Urban Health Centre | 50,094 | 15,025 | 233.40 |
| 333 | Ndola | Mahatma Gandhi | Urban Health Centre | | 19,348 | |
| 334 | Ndola | Masala Main | Urban Health Centre | 10,726 | 10,852 | 1.16 |
| 335 | Ndola | Masala New | Urban Health Centre | 44,811 | 31,351 | 42.93 |
| 336 | Ndola | Mery Berg | Urban Health Centre | | 8,116 | |
| 337 | Ndola | Miramar | Urban Health Centre | | 1,466 | |
| 338 | Ndola | Mpendwa | Urban Health Centre | | 550 | |
| 339 | Ndola | Mushili | Urban Health Centre | 53,652 | 34,765 | 54.33 |
| 340 | Ndola | Nalwange Family | Clinic | | 790 | |
| 341 | Ndola | Ndeke (Ndola) | Urban Health Centre | 14,987 | 12,571 | 19.22 |
| 342 | Ndola | Ndola Central | Hospital Affiliated Health Centre | | 49,341 | |
| 343 | Ndola | Ndola Central Hospital | Hospital | | 11,038 | |

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| 344 | Ndola | Ndola Central Hospital | Hospital Affiliated Health Centre | | 26,980 | |
| 345 | Ndola | Ndola Lime | Urban Health Centre | | 2,429 | |
| 346 | Ndola | Nkhwazi | Urban Health Centre | 34,952 | 11,720 | 198.23 |
| 347 | Ndola | Nortec | Urban Health Centre | | 10,078 | |
| 348 | Ndola | Northern Breweries | Urban Health Centre | | 1,276 | |
| 349 | Ndola | Peter Singogo Police | Urban Health Centre | 3,998 | 9,807 | 59.23 |
| 350 | Ndola | Railway Surgery | Urban Health Centre | 37,623 | 17,595 | 113.83 |
| 351 | Ndola | Sathya Sai | Urban Health Centre | | 11,725 | |
| 352 | Ndola | Satyam | Urban Health Centre | | 832 | |
| 353 | Ndola | TDRC | Urban Health Centre | | 1,617 | |
| 354 | Ndola | Telnor | Urban Health Centre | | 7,388 | |
| 355 | Ndola | Tug-Argan | Urban Health Centre | 9,632 | 11,142 | 13.55 |
| 356 | Ndola | Twapia | Urban Health Centre | 24,078 | 18,142 | 32.72 |
| 357 | Ndola | Villa | Urban Health Centre | | 745 | |
| 358 | Ndola | Zambia Sugar | Urban Health Centre | | 10,078 | |
| 359 | Ndola | Zesco | Urban Health Centre | | 1,675 | |
| 360 | Ndola | ZFDS Medical Centre | Urban Health Centre | | 1,409 | |
| 361 | Ndola | Chipulukusu | | 42,689 | | |
| 362 | Ndola | Pamodzi | | 23,901 | | |